Assessing the Environmental Impact of 18 Selected Waste Disposal Sites

Phase II, Manitoba Landfill Study, April 1986

Manitoba
Environment and
Workplace Safety
and Health

Assessing the Environmental Impact of 18 Selected Waste Disposal Sites in Manitoba

Phase II Manitoba Landfill Study

April 1986

prepared by
G. S. Karp, B.Sc.
Geotechnical Consultant

For

Manitoba Department of Environment and
Workplace Safety and Health

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SUMMARY

In 1985, the Manitoba Phase II assessment of 18 waste disposal sites was undertaken. The sites investigated are: Argyle, Birch River, Bowsman, Carman, Cowan, Elkhorn, Husavick Road, Gladstone, Grandview, MacGregor, Melita, Neepawa, Roblin, Russell, St. Claude, Teulon, Treherne, and Westbourne.

For each of the selected sites, a site inspection and a technical data review was carried out. Further investigation included one or more of the following: test hole drilling, the installation of monitoring wells, the installation of methane gas probes, and the sampling of residential wells.

It was found that the operational aspects for the sites of Birch River, Carman, Elkhorn and Melita, required improvement; recommendations were made accordingly.

The sites of Argyle, Cowan, MacGregor and St. Claude were found to exhibit varying degrees of groundwater contamination in the site areas, however no residential wells were known to be affected. In addition to recommending improvements of operational practices it is also recommended that further monitoring of area wells be conducted.

INTRODUCTION

Throughout Canada projects undertaken by provincial environmental agencies have been carried out to evaluate land disposal sites due to the concerns with public health and environmental problems.

In Manitoba, 760 active and inactive waste disposal sites were identified in the 1982 I.D. Systems report, "Identification and Verification of Active and Inactive Land Disposal Sites in Manitoba". Twenty one of these sites received phase II investigation in 1983, 24 in 1984 and an additional 18 were chosen in 1985 for phase II investigation.

The objective of the phase II study was to investigate the waste disposal sites in order to determine their potential impact on the environment. These investigations included:

1. A site inspection
2. Confirmation of location.
3. Air photo and map interpretation
4. Hydrogeological interpretation
5. Test hole drilling, monitoring well and/or methane probe installation where applicable.
6. Monitoring of groundwater, surface water, and methane probes if applicable.
7. Interpretation and evaluation of all data collected.

The field work for this report was conducted in the months of August, September and October.

CHAPTER - ONE -

ARGYLE

R. M. OF WOODLANDS

NW 25-14-1W

1 ARGYLE WASTE DISPOSAL SITE

1.1 RECONNAISSANCE DATA

1.1.1 LOCATION

The Community of Argyle is located in the R.M. of Woodlands, approximately 30 kilometres north west of Winnipeg along P.R. 323. The waste disposal site is located approximately 5 kilometres north of the community on Section NW 25-14-1W (see Figures 1.1 and 1.2 in Appendix A).

1.1.2 BACKGROUND

This waste disposal site has been operating in its present location for over ten years. In 1977 the site was registered with the Province as an existing waste disposal grounds by the R.M. of Woodlands. Current records show that this site serves approximately 600 people. Primarily municipal waste from the Community of Argyle and household waste from surrounding rural residents in the R.M.'s of Woodlands and Rockwood is deposited at this site. An open dumping terrace method is used with no bulky metallic or separate agricultural chemical container area. Area residents derive water from the bedrock or surficial aquifers in the area.

1.1.3 SITE CONDITIONS

During the site inspection on July 8, 1985, several observations were made. The site is located immediately off of a section road running east-west, approximately 5 kilometres north of the community of Argyle. The site covers an area of approximately 75 m by 75 m with an active area consisting of a dumping terrace 1 metre high, and approximately 50 metres long. Waste is deposited at the edge of the terrace and burned, pushed over the edge and mixed with fill several times per year.

The site is not fenced, and waste has been strewn throughout the area and is found on both sides of the section road. Several open pools of water are found on the site, with the dumping terrace encroaching on one of these. The site is located in an abandoned sand pit with the water table close to the surface grade. The site is in an unkempt condition; site location is poor, due to pools of water on the site, and shallow ground water levels. The nearest residence to the site is located 1.5 kilometres to the south.

1.1.4 PHYSIOGRAPHY

The site is located in the Manitoba Lowlands, Red River Plain, on the prairie level which connects Lake Manitoba and Lake Winnipeg. The relief is lightly rolling with a gentle dip towards Lake Winnipeg.

Agricultural fields dominate the region with areas of woods interspersed in the landscape. Regional drainage is to the south while site drainage appears to be absent, as precipitation migrates directly through the sandy topsoil.

1.1.5 DRILLING AND SAMPLING

A drilling and sampling program was undertaken at this site. A monitoring well was installed and two surface water and one ground water sample was taken. Analytical results can be found in Appendix B, drill logs can be found in Appendix C.

1.2 GEOLOGIC DATA

1.2.1 GEOLOGIC SETTING

During the last ice age the shores of Glacial Lake Agassiz were located in the Argyle area during one stage of its development. During the period in which Glacial Lake Agassiz's north shore was located south of the 50th parallel, sand was deposited as beach deposits in this area, over the till. (See Figure 1.3 and 1.4 in Appendix A).

1.2.2 BEDROCK

Fractured Dolomite of the silurian period underlies the site at a depth of approximately 30 metres below grade.

1.2.3 OVERBURDEN

Bedrock is overlain with approximately 30 metres of surficial deposits consisting of two units. The lower unit consists of approximately 27 metres of highly calcareous till with varying degrees of permeability. The upper unit consists of 3 metres of sand exhibiting good permeabilities.

1.2.4 GEOHYDROLOGY

Two types of aquifers are found in this area. The deep bedrock aquifer in the dolomite at approximately 30 metres below grade is the primary water source for the area, with good quality water reported.

The second aquifer consists of the minor surficial unconfined sand deposits in the site area. Ground water level is approximately 1 metre below grade on average, with several low lying areas on the site, located below groundwater level, as seen by the open water pools.

1.3 ENVIRONMENTAL INTERPRETATION AND ASSESSMENT

1.3.1 LEACHATE HYDROLOGY

The quantity of leachate generated on this site is high as waste is deposited in low lying areas, and in the water pools, yielding a continuing source of leachate.

Leachates are suspected to be migrating from the site location. The bedrock aquifer is most likely not affected by this contamination as it is protected by a thick glacial till unit.

Overall the migration distance and dispersion pattern of the leachate in the surficial aquifer, is unknown, however it is suspected that leachates mushroom out around the site and flow southeast in the direction of the groundwater flow.

1.3.2 METHANE

Based on the amount of waste deposited at this site an estimated 1.6 million cubic metres of methane gas may be generated per year. Since the majority of waste is burned before fill covering, the actual suspected quantity of methane gas generated will only be a fraction of the estimate. Migration distance of any methane gas generated should be limited to several metres, based on soil conditions.

1.3.3 WATER QUALITY

Analytical results of the three water samples indicates some groundwater contamination is occurring. Sample #1 of an upstream water pool shows low concentrations of metal ions, low hardness, chloride, sulphate, and nitrate levels, and can be considered good quality water.

The downstream monitoring well, Sample #2, shows higher then background levels of metal ions including the arsenic, cadmium, lead, chromium, manganese and iron ions. The nitrate level approaches the maximum acceptable limit, while the sulphate and chloride levels are 10 times higher then the upstream levels. This water can be considered poor in quality. The third sample of a water pool, encroached by the waste terrace indicates some contamination in the form of higher then upstream levels of chloride, sulphate and nitrate parameters, along with high fecal and total coliform levels.

1.3.4 CONCLUSION

Based on the available data to date this site poses a moderate environmental impact to the area. This site appears to cause a moderate degree of groundwater contamination in the shallow surficial sand aquifer. The extent of the contamination is unknown, however, it is suspected that dispersion, dissipation and attenuation will occur further away from the site. The unkempt condition of the site, i.e. blowing and strewn debris on both sides of the road is unacceptable.

1.3.5 RECOMMENDATIONS

1. Strewn waste located on and around the site area should be collected.
2. A separate bulky metallic waste pile should be established.
3. No liquid wastes should be deposited at this site.
4. A fence should be erected to contain blowing debris.

APPENDIX A

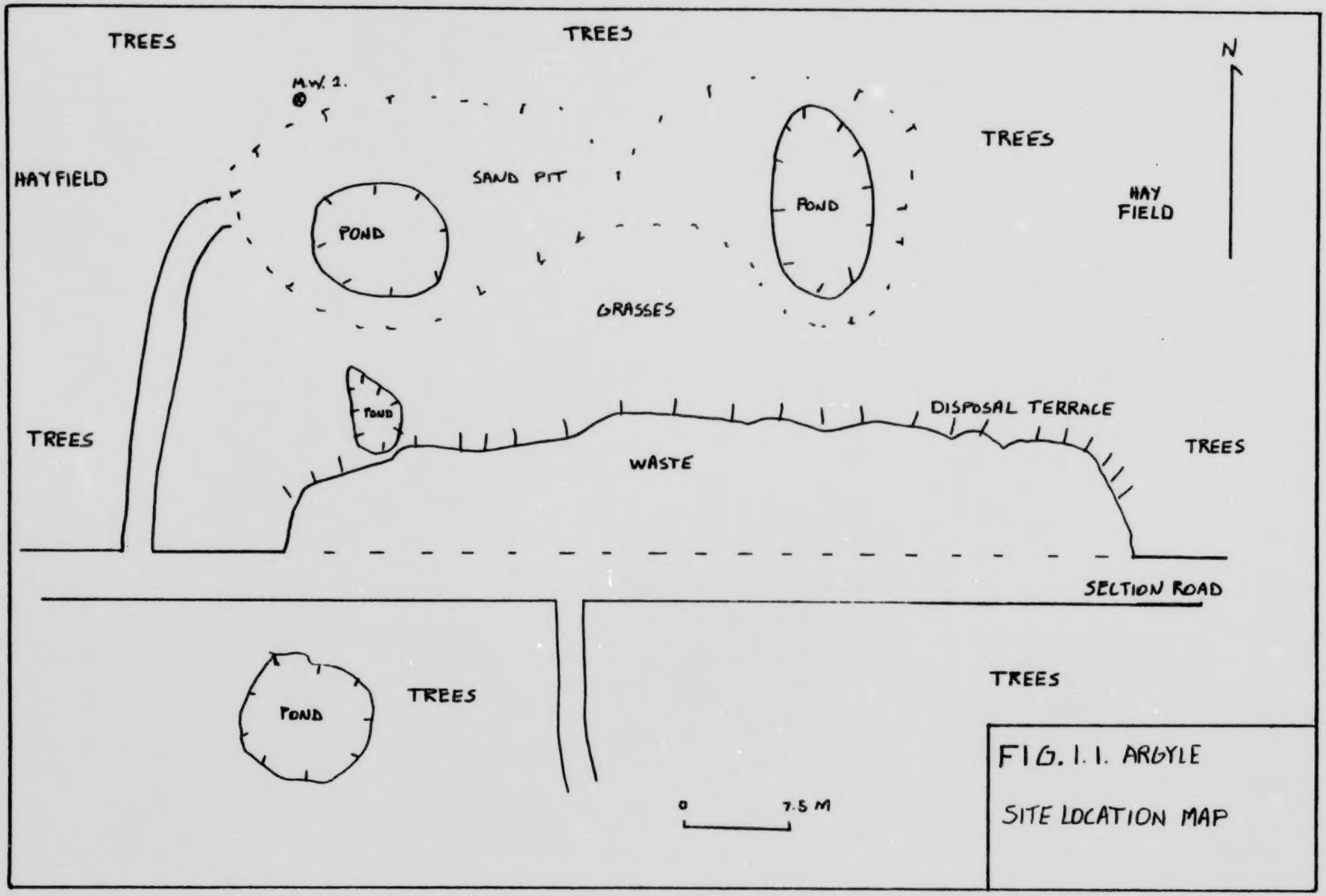

TREES
TREES
M.W. 2.
HAYFIELD
SAND PIT
POND
POND
TREES
HAY FIELD
N
GRASSES
TREES
POND
DISPOSAL TERRACE
WASTE
TREES
SECTION ROAD
POND
TREES
TREES
0
7.5 M

FIG. 1.1. ARGYLE

SITE LOCATION MAP

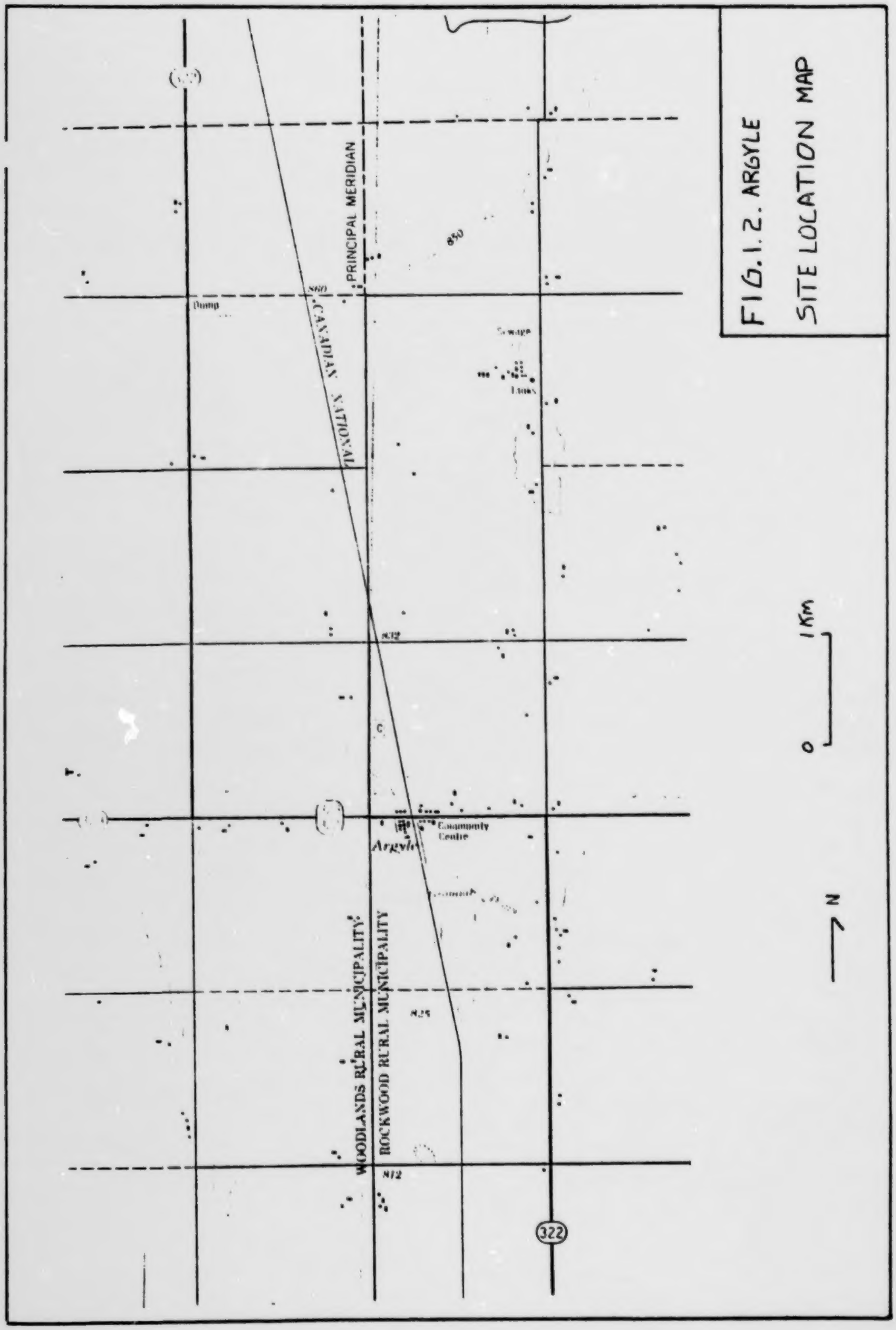


FIG. 1.2. ARGYLE SITE LOCATION MAP

PRINCIPAL MERIDIAN
CANADIAN NATIONAL
WOODLANDS RURAL MUNICIPALITY
ROCKWOOD RURAL MUNICIPALITY
Argyle
Community Centre
Sewage Lagoons
Dump
880
850
832
825
812
322
0
1 KM
N

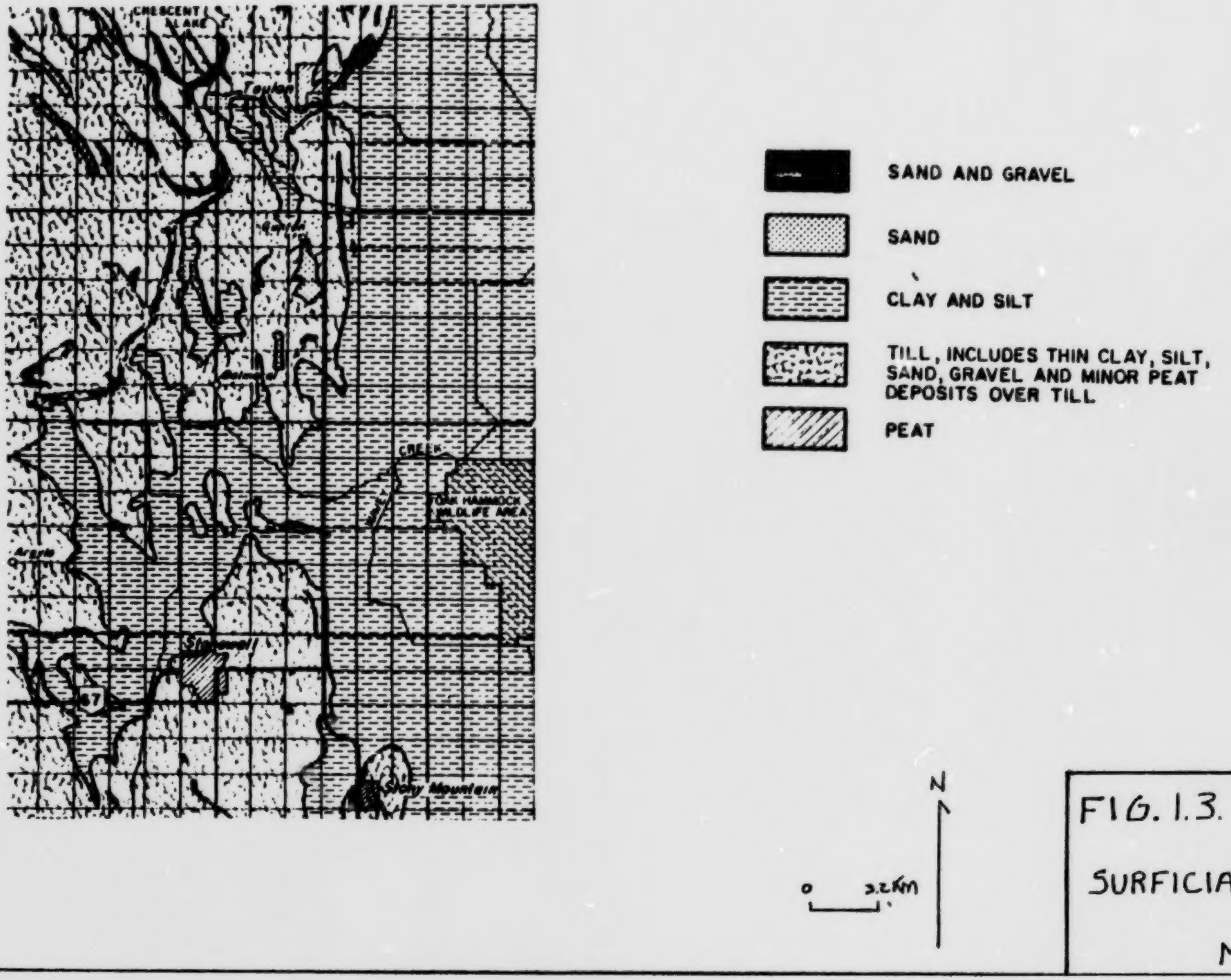

CRESCENT LAKE
Teulon
Gunton
Balmoral
CREEK
OAK HAMMOCK WILDLIFE AREA
Argyle
Stonewall
67
Stony Mountain
■ SAND AND GRAVEL
▒ SAND
▤ CLAY AND SILT
▒ TILL, INCLUDES THIN CLAY, SILT, SAND, GRAVEL AND MINOR PEAT DEPOSITS OVER TILL
▨ PEAT
N
0
3.2 km

FIG. 1.3. ARGYLE

SURFICIAL DEPOSITS

MAP

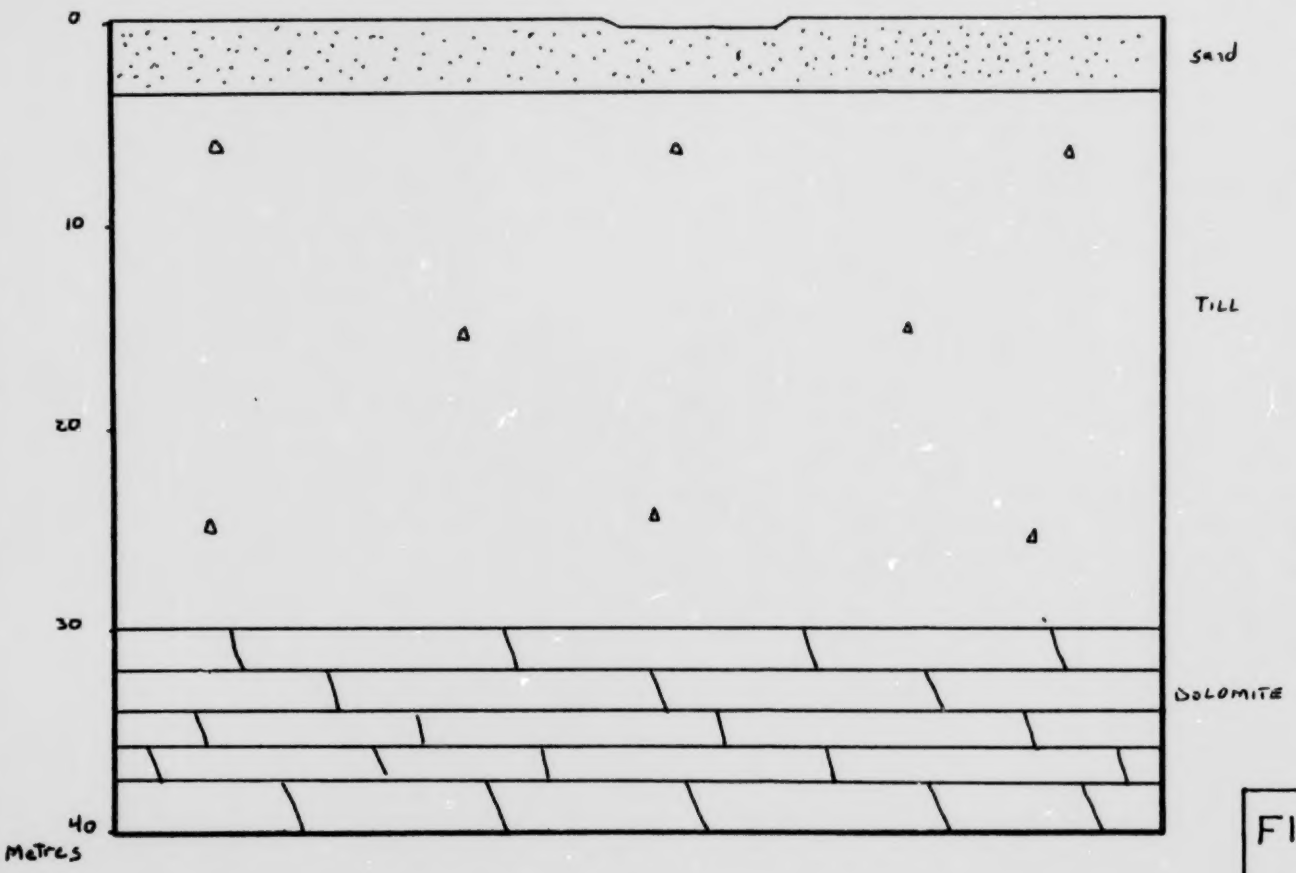

0
10
20
30
40
Metres
sand
TILL
DOLOMITE

FIG.1.4. ARGYLE GEOLOGIC CROSS SECTION

APPENDIX B

WATER QUALITY ANALYSIS

LOCATION: Argyle
SAMPLE #: Dugout Sample One
DATE: September 16, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	496	umho/cm
Residue Total	310	mg/l
Residue Filterable	310	mg/l
Residue Non Filterable	<5.	mg/l
pH	8.20	units
Alkalinity Total ($CaCO_3$)	268	mg/l
Alkalinity (HCO_3)	327	mg/l
Alkalinity (CO_3)	0	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	<.001	mg/l
Cadmium (Ext)	<.001	mg/l
Copper (Ext)	.01	mg/l
Lead (Ext)	<.005	mg/l
Nickel (Ext)	<.005	mg/l
Zinc (Ext)	.02	mg/l
Chromium (Ext)	<.005	mg/l
Calcium (Ext)	57.9	mg/l
Magnesium (Ext)	25.6	mg/l
Hardness ($CaCO_3$)	250	mg/l
Manganese (Ext)	<.02	mg/l
Iron (Ext)	.04	mg/l
Potassium (Ext)	<5.00	mg/l
Sodium	2.2	mg/l
COD	32	mg/l
TOC	–	mg/l
Turbidity	1.5	NTU
CN (Total)	<.02	mg/l
Kjeldhal, Total, -N	.80	mg/l
NH_3-N. Sol.	<.02	mg/l
NO_3-NO_2-N	<.01	mg/l
Phosphate Total	.025	mg/l
Chloride	2.0	mg/l
Sulphate	6.8	mg/l
Coliform Group	240	per 100 ml
Fecal Coliform	9	per 100 ml

WATER QUALITY ANALYSIS

LOCATION: Argyle
SAMPLE #: Monitoring Well Sample Two
DATE: September 16, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	1520	umho/cm
Residue Total	2830	mg/l
Residue Filterable	1170	mg/l
Residue Non Filterable	1660	mg/l
pH	7.35	units
Alkalinity Total ($CaCO_3$)	488	mg/l
Alkalinity (HCO_3)	595	mg/l
Alkalinity (CO_3)	0	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	.007	mg/l
Cadmium (Ext)	.002	mg/l
Copper (Ext)	.08	mg/l
Lead (Ext)	.0249	mg/l
Nickel (Ext)	.024	mg/l
Zinc (Ext)	.30	mg/l
Chromium (Ext)	.044	mg/l
Calcium (Ext)	358	mg/l
Magnesium (Ext)	168	mg/l
Hardness ($CaCO_3$)	1587	mg/l
Manganese (Ext)	.54	mg/l
Iron (Ext)	11.2	mg/l
Potassium (Ext)	<5.00	mg/l
Sodium	26.0	mg/l
COD	80	mg/l
TOC	-	mg/l
Turbidity	1200	NTU
CN (Total)	<.02	mg/l
Kjeldhal, Total, -N	2.3	mg/l
NH_3-N. Sol.	.20	mg/l
NO_3-NO_2-N	8.40	mg/l
Phosphate Total	.85	mg/l
Chloride	102	mg/l
Sulphate	220	mg/l
Coliform Group	3	per 100 ml
Fecal Coliform	0	per 100 ml

WATER QUALITY ANALYSIS

LOCATION: Argyle

SAMPLE #: Waste Dugout

DATE: September 16, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	1540	umho/cm
Residue Total	1080	mg/l
Residue Filterable	1040	mg/l
Residue Non Filterable	44	mg/l
pH	7.30	units
Alkalinity Total ($CaCO_3$)	600	mg/l
Alkalinity (HCO_3)	732	mg/l
Alkalinity (CO_3)	0	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	.001	mg/l
Cadmium (Ext)	<.001	mg/l
Copper (Ext)	<.01	mg/l
Lead (Ext)	<.005	mg/l
Nickel (Ext)	<.005	mg/l
Zinc (Ext)	.11	mg/l
Chromium (Ext)	<.005	mg/l
Calcium (Ext)	167	mg/l
Magnesium (Ext)	72.9	mg/l
Hardness ($CaCO_3$)	718	mg/l
Manganese (Ext)	1.01	mg/l
Iron (Ext)	3.42	mg/l
Potassium (Ext)	37.0	mg/l
Sodium	25.6	mg/l
COD	64	mg/l
TOC	–	mg/l
Turbidity	10	NTU
CN (Total)	<.02	mg/l
Kjeldhal, Total, -N	4.3	mg/l
NH_3-N. Sol.	1.6	mg/l
NO_3-NO_2-N	4.00	mg/l
Phosphate Total	1.1	mg/l
Chloride	92	mg/l
Sulphate	136	mg/l
Coliform Group	4600	per 100 ml
Fecal Coliform	93	per 100 ml

APPENDIX C

GEOLOGIC LOG

LOCATION: Argyle Waste Disposal Site

TEST HOLE IDENTIFICATION: M.W. 1

DATE: July 13, 1985

TOTAL DEPTH: 5 Metres

WATER TABLE: 1.5 Metres

TYPE OF CASING: PVC 1.5 Inch Sch. 40

TYPE OF SCREEN: Polypropylene Weave

SLOTTING LENGTH: 2-5 metres

FILL MATERIAL: Silica sand, 30-40 grade

DEPTH (METRES)	DESCRIPTION
0 - 2.4	sand, medium
2.4 - 4.2	clayey sand
4.2 - 5.0	clay

CHAPTER - TWO -

BIRCH RIVER

L.D.G. OF MOUNTAIN-NORTH

SW 27-39-26W

2 BIRCH RIVER WASTE DISPOSAL SITE

2.1 RECONNAISSANCE DATA

2.1.1 LOCATION

The community of Birch River is located in the L.G.D. of Mountain-North and is located approximately 40 kilometres north of Swan River along P.T.H. 10. The site is located approximately 1.2 kilometres southwest of the community, on Section SW 27-39-26W (see Figures 2.1. and 2.2 in Appendix A).

2.1.2 BACKGROUND

This waste disposal site has been operating in its current location for over 5 years and is unregistered. The previous site which was located 1 mile north and registered in 1977 has been closed.

The site serves a population of approximately 900 people. Primarily municipal waste from the community of Birch River and household waste from surrounding rural areas is deposited at this site.

Water supply for the community is derived from one deep well set into the bedrock aquifer. Rural residents derive water from either the deep bedrock aquifer or the shallow surficial aquifers.

The waste disposal method used at this site is trench burning followed by burial. Sewage is also deposited at this site in an abandoned gravel pit.

2.1.3 SITE CONDITIONS

During the site inspection on September 11, 1985 several observations were made. This site is located approximately 40 metres east of P.T.H. 10, and access to the site is from a gravel road running southeast from P.T.H. 10.

The site covers an area of approximately 50 metres by 70 metres, with three major active areas. The main active area is a trench located on the east part of the site, approximately 35 metres long, 2 metres wide and 2 metres deep. The construction and bulky metallic waste area is located in the centre section of the site. To the extreme west of the site a dirt path leads to a sewage truck unloading area. Sewage is allowed to flow down the side of an embankment into an abandoned gravel pit approximately 30 metres by 30 metres by 5 metres deep. Liquid level in this pit is estimated at .5 metres.

The site is fenced on the east side only, to protect a field and forest area from blowing debris. The site condition is moderately unkept as strewn waste litters the road access ways. Although the site is located over 400 metres from the nearest dwelling, the site location is considered poor as it is located on gravel deposit which is suspected to form a limited unconfined aquifer. No residences are located downstream of the immediate site area.

2.1.4 PHYSIOGRAPHY

The site is located on the edge of the Manitoba lowlands on the extreme western edge of the Interlake-Westlake plain, on a narrow strip of land which connects the Porcupine and Duck Mountains. Less than a kilometre to the west the Porcupine Mountain slopes sharply. To the north of the site several streams form back cutting channels and provides drainage for the eastern slope of Porcupine Mountain.

The site is located in an abandoned gravel pit in a forested area. To the west of the site a gravel pit is still in operation.

2.1.5 DRILLING AND SAMPLING

A drilling and sampling program was not undertaken at this site.

2.2 GEOLOGIC DATA

2.2.1 GEOLOGIC SETTING

The site is located in an extensive near shore washed out till deposit which forms the boundary between Porcupine Mountain and the central Manitoba lowlands. Interbedded gravel and sand overlie clayey till which in turn overlies the bedrock. (See Figure 2.3 in Appendix A).

2.2.2 BEDROCK

At a depth of approximately 30 metres, shale of the Cretaceous period underlies the site.

2.2.3 OVERBURDEN

Two distinct units form approximately 30 metres of overburden at this site. The lower unit consists of approximately 25 metres of highly calcareous clay till. The upper unit consist of 5 metres of outwashed till, with interbedded layers of sand and gravel.

2.2.4 GEOHYDROLOGY

At depth, the bedrock forms a confined aquifer. The community obtains its drinking water supply from this aquifer and several wells are reported to be using this aquifer in the site area.

Intermittent unconfined and partially confined aquifers in the outwashed deposits of gravel and sand exist in the area. The waste disposal site is suspected to be located on such an aquifer, the groundwater level is suspected to be approximately 3-5 metres below grade.

2.3 ENVIRONMENTAL INTERPRETATION AND ASSESSMENT

2.3.1 LEACHATE HYDROLOGY

The bedrock aquifer at depth is protected from leachate contamination by the relatively impermeable till which forms the confining layer.

Potential sewage contamination of the shallow surficial aquifer in the gravel and sand outwashed deposits is high. Also, leachate is generated during times of snowmelt and precipitation, while migration of leachates is directly into the groundwater, through the permeable soil and surficial sediments.

Groundwater flow is easterly towards the Birch River located several kilometres to the east.

2.3.2 METHANE

Based on the amount of waste deposited on this site an estimated 1.2 million cubic metres of methane gas per year may be generated. Since the majority of waste is burned before burial the actual suspected quantity of methane gas generated will only be a fraction of the estimate. Methane gas migration should be limited to a radius of 20 metres around the site, based on soil conditions.

2.3.3 WATER QUALITY

Water quality of the deep bedrock aquifer is reported fair to good in the area, and should not be effected by the disposal site.

Water quality of gravel and sand aquifers in the area is reported to be good. Water quality downstream of the site is suspected to be effected by the site operation, to an unknown extent.

2.3.4 CONCLUSION

Based on the data available to date, local contamination of the unconfined surficial aquifer is suspected. Any contaminate flow will be easterly in the direction of the groundwater gradient. The extent of the affected aquifer is unknown, however, contamination of wells located several kilometres to the east does not appear likely.

Site operation can be improved, as strewn waste along the access road occurs. Sewage disposal at this site which is currently being deposited in an abandoned gravel pit, in is unacceptable.

2.3.5 RECOMMENDATIONS

1. A proper liquid waste disposal facility should be established.
2. Strewn waste around the site should be collected and signs posted indicating dumping and no dumping areas.

APPENDIX A

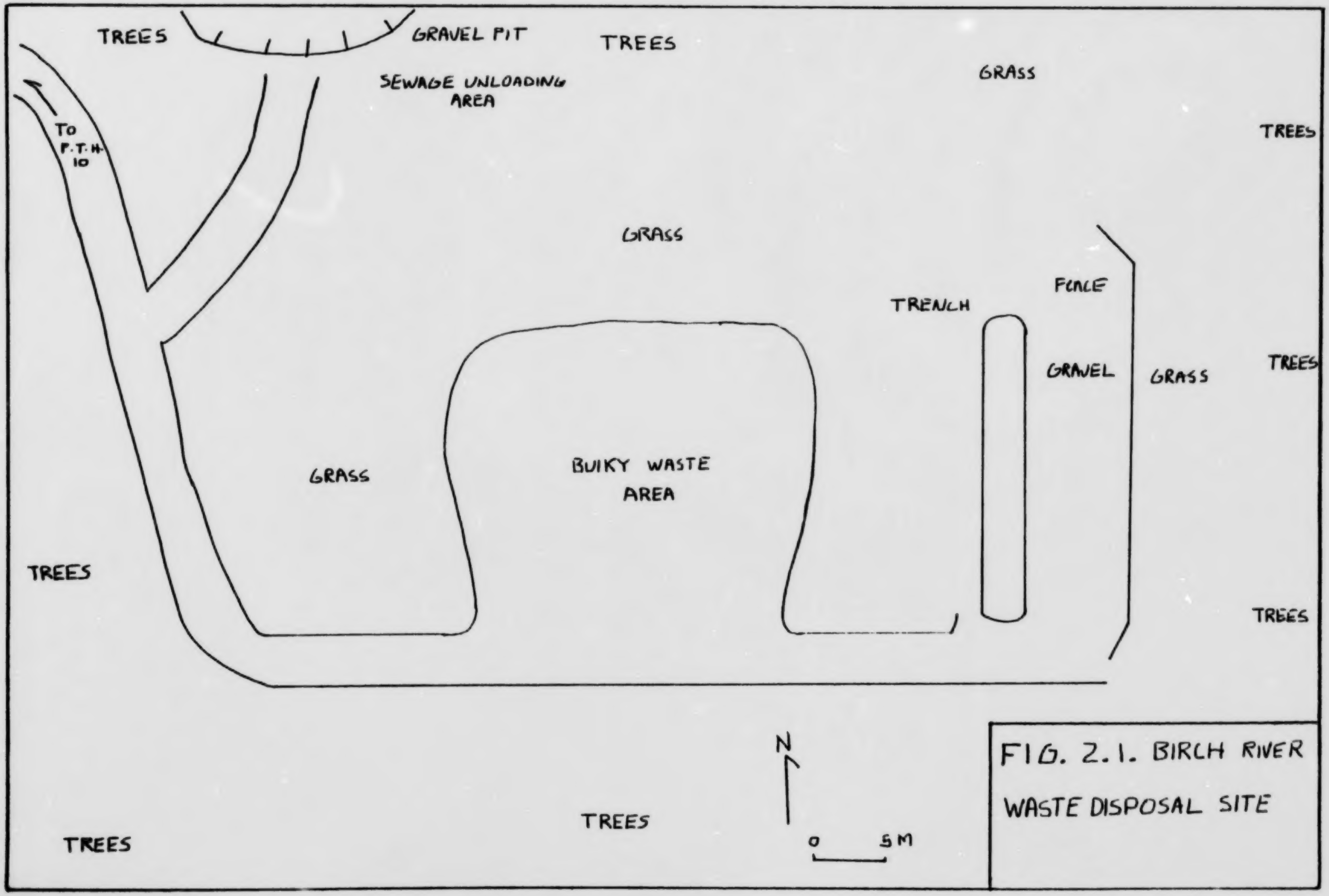

TREES
GRAVEL PIT
TREES
SEWAGE UNLOADING AREA
GRASS
TREES
To P.T.H. 10
GRASS
FENCE
TRENCH
GRAVEL
GRASS
TREES
BUIKY WASTE AREA
GRASS
TREES
TREES
TREES
N
0
5M
TREES

FIG. 2.1. BIRCH RIVER WASTE DISPOSAL SITE

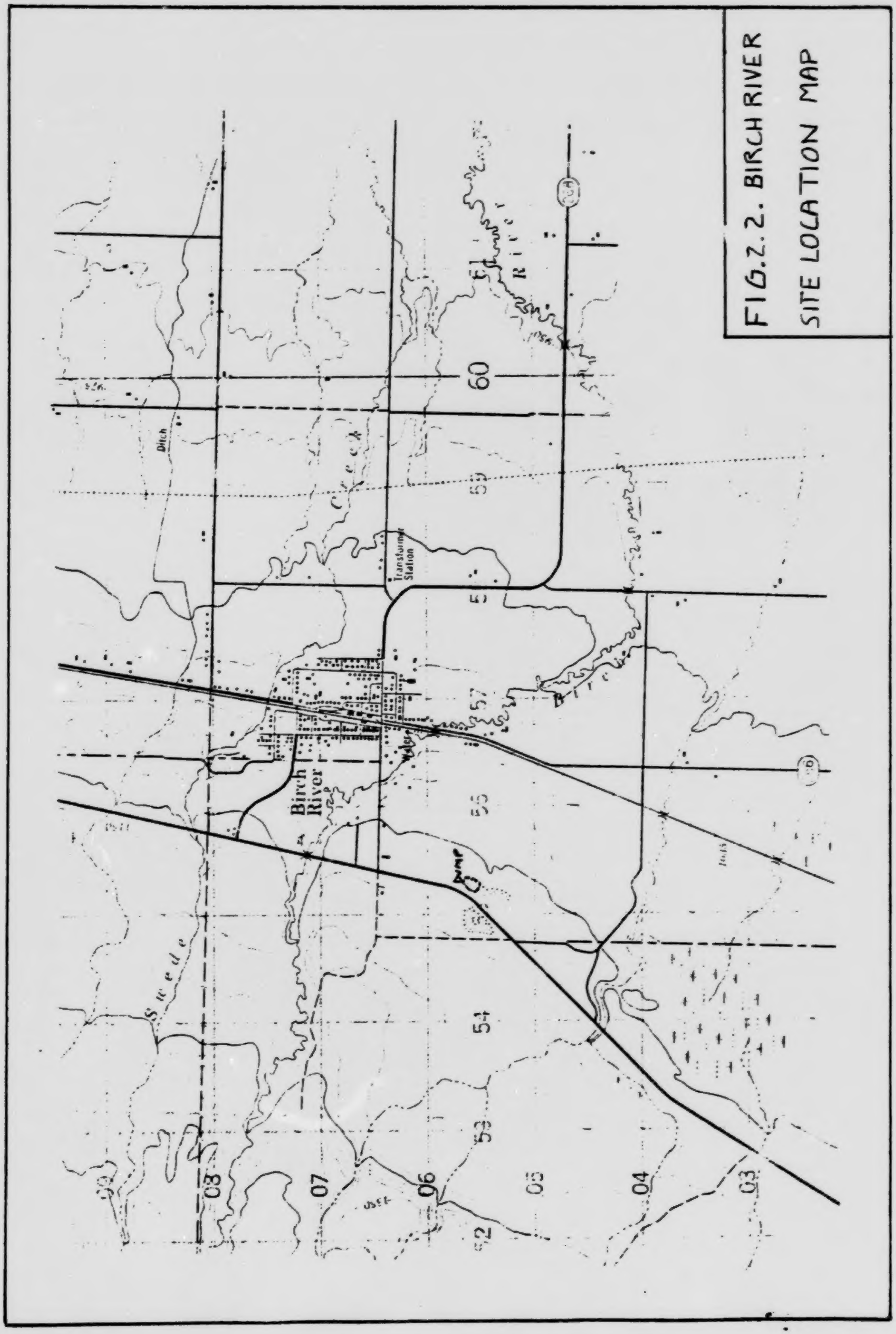

Birch River
Transformer Station
Water
Ditch
Swede
Creek
River
Birc
60
59
58
57
56
55
54
53
52
08
07
06
05
04
03

FIG. 2.2. BIRCH RIVER SITE LOCATION MAP

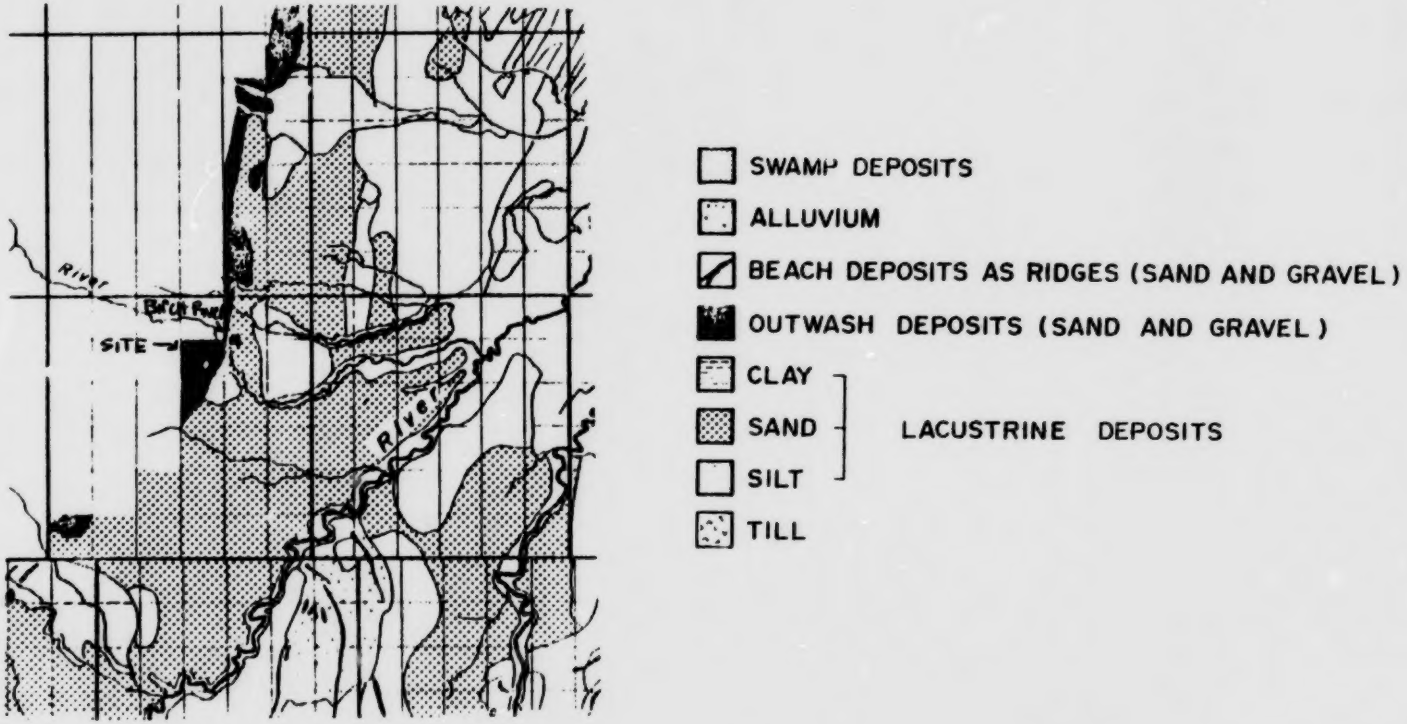

River
Birch River
SITE
River
SWAMP DEPOSITS
ALLUVIUM
BEACH DEPOSITS AS RIDGES (SAND AND GRAVEL)
OUTWASH DEPOSITS (SAND AND GRAVEL)
CLAY
SAND
SILT
LACUSTRINE DEPOSITS
TILL

FIG. 2.3. BIRCH RIVER SURFICIAL DEPOSITS MAP

CHAPTER - THREE -

BOWSMAN

R.M. OF MINITONAS

SW 24-38-27W

3 BOWSMAN WASTE DISPOSAL SITE

3.1 RECONNAISSANCE DATA

3.1.1 LOCATION

The Village of Bowsman is located approximately 10 kilometres northwest of Swan River along P.T.H. 10. The waste disposal site is located approximately 5 kilometres north of the town on Section SW 24-38-27W (see Figures 3.1 and 3.2, in Appendix A).

3.1.2 BACKGROUND

The waste disposal site has been operating in its present location for over ten years. In 1977 the site was registered with the Province as an existing waste disposal grounds. Current records show that this site serves approximately 600 people. Primarily municipal waste from the Town of Bowsman and household waste from surrounding rural areas is deposited at this site. A trench system is used to dispose of common waste, while chemical pesticide containers are collected on the surface. Water supply for the area is derived from the surficial sand aquifer or from the deep bedrock aquifer, depending on location and water availability in a given aquifer.

3.1.3 SITE CONDITIONS

During the site inspection on September 11, 1985, several observations were made. The site is located immediately east of a section road which runs north-south, and is approximately 130 metres by 130 metres in size. Only the east side of the site is currently in use. A trench 80 metres long, 4 metres wide and 2 metres deep, and an agricultural chemical containers pile, makes up the active area. The waste in the trench is deposited and burned, and when full, covered with fill.

The site condition is good, and is fenced with a gate. A sign is posted indicating dumping instructions. However, it appears the agricultural chemical container area is not being utilized by the public. Chemical containers were seen deposited in the trench and burning along with other wastes. Also large bulky metallic wastes were deposited in the trench, as there is no separate bulky metallic waste disposal area.

The nearest residence is located 450 metres to the north, with an abandoned farm residence located immediately west of the site.

3.1.4 PHYSIOGRAPHY

The site is located in the western uplands, on the Swan River Plain, on the prairie level which connects Duck and Porcupine Mountains. The area is characterized by gently sloping sand flats, with a small creek located 1 kilometre north of the site incised 2 metres into the prairie level.

Land use and vegetation consists of agricultural fields with several treed areas around dwellings.

3.1.5 DRILLING AND SAMPLING

No drilling program was undertaken at this site. A water sample was taken from a nearby residence well located 450 metres south of the site. (See Appendix B for water analytical results).

3.2 GEOLOGIC DATA

3.2.1 GEOLOGIC SETTING

The site is located on an extensive sand flat area, which marks the edge of an ancient proglacial lake, as seen by lacustrine beach deposits overlying till which in turn overlies bedrock (Figure 3.3 in Appendix A).

3.2.2 BEDROCK

At a depth of approximately 55 metres, shale, unconsolidated sand and sandstone bedrock of the Cretaceous Period underlies the site.

3.2.3 OVERBURDEN

Two distinct units form approximately 55 metres of overburden overlying bedrock. The lower unit consists of approximately 52 metres of highly calcareous till with many gravel and sand lenses present. The upper three metres consists of silty sand.

3.2.4 GEOHYDROLOGY

The sandstone bedrock at depth forms the major bedrock aquifer of this area, also many minor aquifers in the sand and gravel lenses of the till can be found and are being utilized by residences in the area. It is suspected that such an aquifer exists in the site area. The area also serves as a recharge zone for surficial aquifers. Ground water flow is easterly towards the Woody River.

3.3 ENVIRONMENTAL INTERPRETATION AND ASSESSMENT

3.3.1 LEACHATE HYDROLOGY

Leachate is generated at this site by precipitation infiltrating the buried waste and migrating into the silty sand and till subsurface. Since there is a probability of sand and gravel aquifers in the immediate site area, localized contamination may occur. Dilution, dispersion and attenuation should decrease any contaminant concentrations with distance from the site.

The bedrock aquifer is not likely affected by the site since it is overlain by over 50 metres of semipermeable till.

3.3.2 METHANE

Based on the amount of waste deposited at this site, an estimated 1.5 million cubic metres of methane gas may be produced per year. Since the waste is burned before burial, the actual suspected quantity of methane gas generated will only be a fraction of the estimate. Migration distance of any methane gas generated should be limited to approximately 30 metres based on the soil conditions.

3.3.3 WATER QUALITY

Water quality of the surficial shallow sand aquifer in the site area, appears to be good. The general characteristics of the water chemistry include a high nitrate parameter which approaches the Canadian drinking water maximum acceptable concentration. All other parameters fall below the Canadian drinking water objective concentrations. Water quality may vary from location to location, depending on the aquifer sampled.

3.3.4 CONCLUSION

Based on the available data to date this site poses a low environmental impact to the area. Due to the occurrence of intermittent unconfined aquifers, contamination may occur in the site area. Since no wells are located in the site area this possibility poses a low concern. Contamination of the deep bedrock aquifer does not appear likely as there is a thick till sequence overlying it. Agricultural chemical pesticide containers seen burning in the trench poses a health hazard to the public utilizing this facility. Overall the site is generally well run and is in good condition.

3.3.5 RECOMMENDATIONS

1. Agricultural pesticide containers should not be deposited or burned in the trench.
2. A separate bulky metallic waste area should be established.

APPENDIX A

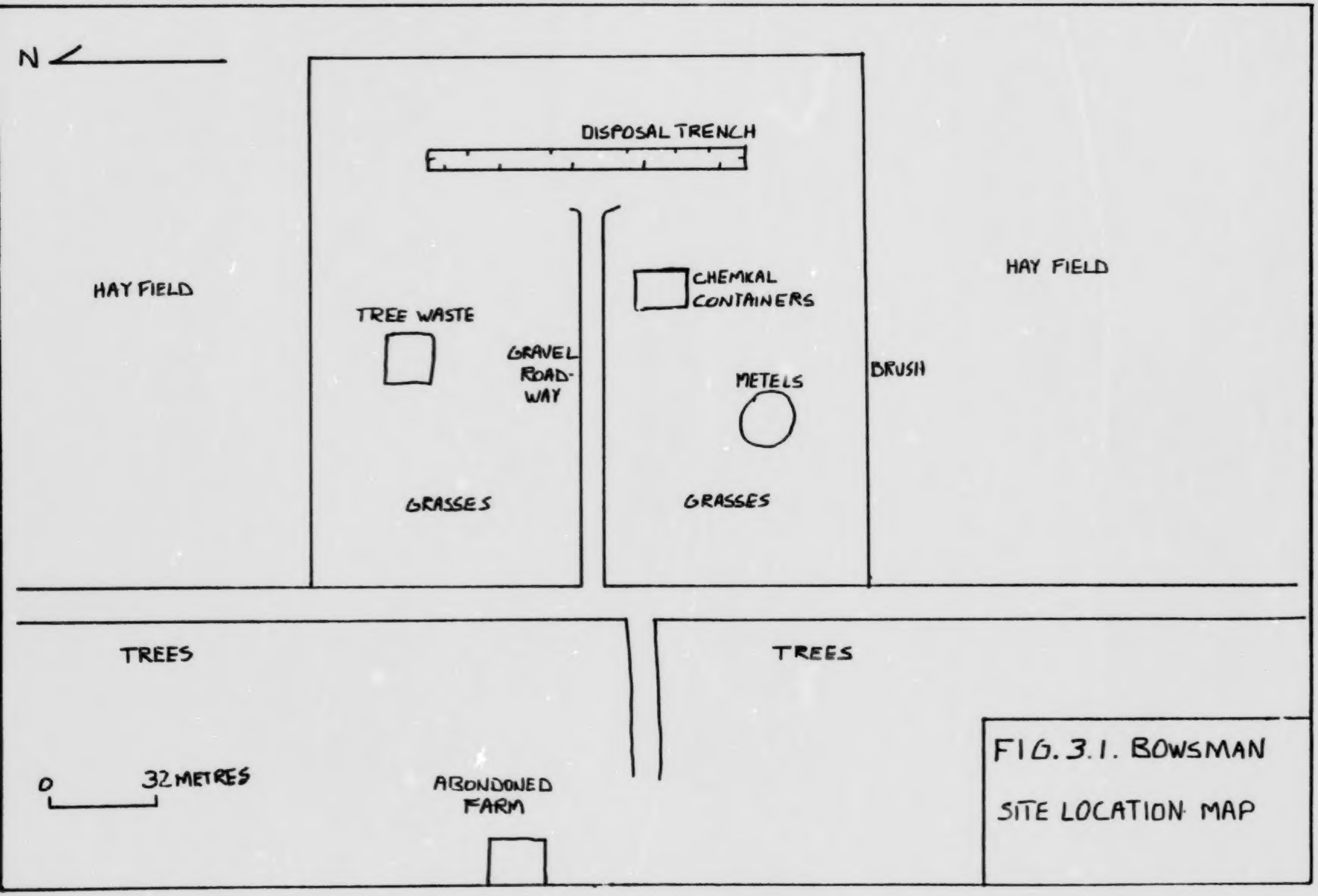

N
HAY FIELD
DISPOSAL TRENCH
TREE WASTE
GRAVEL ROAD-WAY
CHEMKAL CONTAINERS
METELS
BRUSH
HAY FIELD
GRASSES
GRASSES
TREES
TREES
0
32 METRES
ABONDONED FARM

FIG. 3.1. BOWSMAN SITE LOCATION MAP

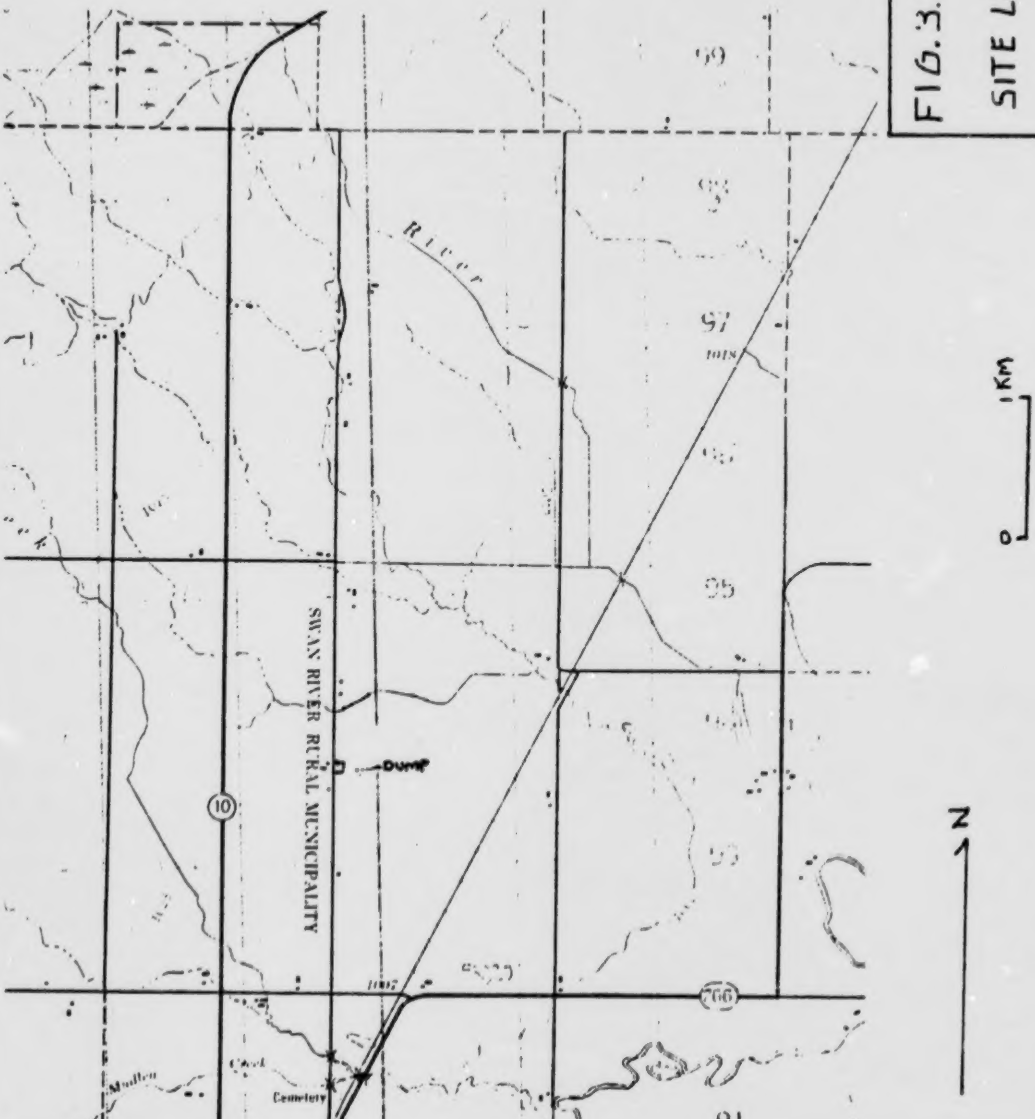

99
97
95
93
91
River
1018
1007
SWAN RIVER RURAL MUNICIPALITY
Dump
10
266
Creek
Cemetery
Swan River 20 km
Bowsman 2 km
0
1 KM
N

FIG. 3.2 BOWSMAN SITE LOCATION MAP

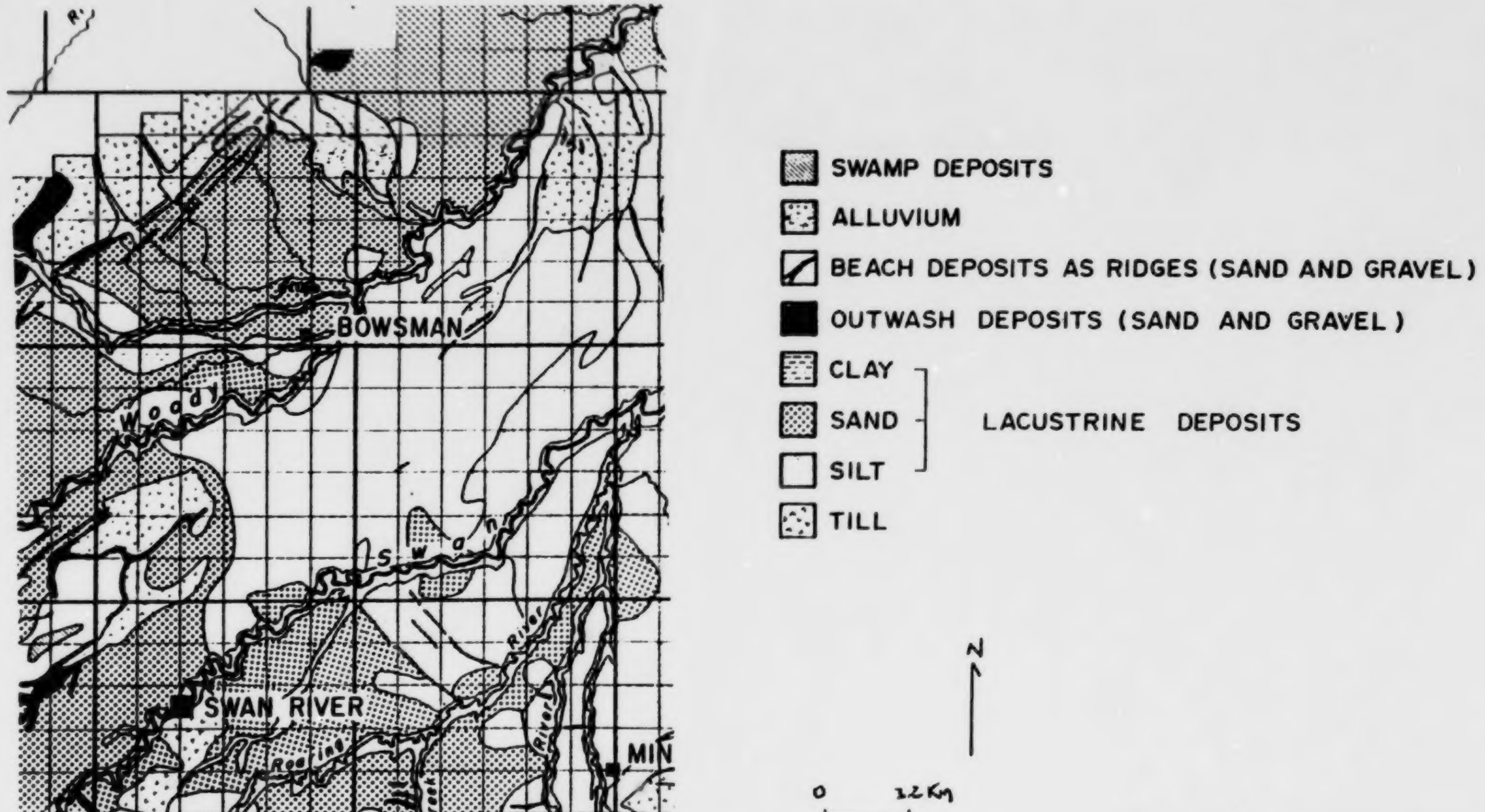

BOWSMAN
Woody
Swan
SWAN RIVER
Roaring
Creek
River
River
MIN
SWAMP DEPOSITS
ALLUVIUM
BEACH DEPOSITS AS RIDGES (SAND AND GRAVEL)
OUTWASH DEPOSITS (SAND AND GRAVEL)
CLAY
SAND
SILT
LACUSTRINE DEPOSITS
TILL
N
0
32 Km

FIG.3.3. BOWSMAN SURFICIAL DEPOSITS MAP

APPENDIX B

WATER QUALITY ANALYSIS

LOCATION: Bowsman
SAMPLE #: Residential Sample One
DATE: September 11, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	572	umho/cm
Residue Total	320	mg/l
Residue Filterable	320	mg/l
Residue Non Filterable	<5.	mg/l
pH	7.55	units
Alkalinity Total ($CaCO_3$)	226	mg/l
Alkalinity (HCO_3)	276	mg/l
Alkalinity (CO_3)	0	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	<.001	mg/l
Cadmium (Ext)	<.001	mg/l
Copper (Ext)	.03	mg/l
Lead (Ext)	<.005	mg/l
Nickel (Ext)	<.005	mg/l
Zinc (Ext)	1.50	mg/l
Chromium (Ext)	<.005	mg/l
Calcium (Ext)	90.9	mg/l
Magnesium (Ext)	19.5	mg/l
Hardness ($CaCO_3$)	307.	mg/l
Manganese (Ext)	<.02	mg/l
Iron (Ext)	<.02	mg/l
Potassium (Ext)	<5.00	mg/l
Sodium	6.82	mg/l
COD	<10.	mg/l
TOC	–	mg/l
Turbidity	.25	NTU
CN (Total)	<.02	mg/l
Kjeldhal, Total, -N	<.20	mg/l
NH_3-N. Sol.	<.02	mg/l
NO_3-NO_2-N	9.20	mg/l
Phosphate Total	<.01	mg/l
Chloride	13	mg/l
Sulphate	20	mg/l
Coliform Group	–	per 100 ml
Fecal Coliform	–	per 100 ml

CHAPTER - FOUR -

CARMAN

R.M. OF DUFFERIN

NW 13-6-5W

4 CARMAN WASTE DISPOSAL SITE

4.1 RECONNAISSANCE DATA

4.1.1 LOCATION

The Town of Carman is located approximately 55 kilometres southwest of Winnipeg along P.T.H. 3. The waste disposal site is located approximately 1.6 kilometres southwest of town on Section NW 13-6-5W (see Figures 4.1 and 4.2. in Appendix A).

4.1.2 BACKGROUND

This waste disposal site has been operating in its present location for over ten years. In 1976 the site was registered with the Province as an existing waste disposal ground. Current records show that this site serves approximately 2500 people. Primarily municipal waste from the Town of Carman and household waste from surrounding rural residents is deposited at this site. An above grade deposition method is used. The town water supply is derived from treated Boyne River water while rural residents derive water from the deep confined aquifer.

4.1.3 SITE CONDITIONS

During the site inspection on September 23, 1985, several observations were made. The site is located at the intersection of two section roads located southwest of town.

The site is approximately 160 metres by 240 metres in size. The main access to the site is from the north, with an auxillary access located in the southwest corner. The site is currently utilizing a large active area, approximately 160 metres by 160 metres, with several major areas of waste deposition.

The first major waste dumping area consists of a dumping terrace about 1.5 metres high with a diameter of 40 metres. Waste is deposited over the edge of this terrace and burned, followed by fill covering.

The second major waste dumping area consists of a field approximately 50 metres by 50 metres and consists of randomly dumped and burned waste piles, with apparently little fill covering.

To the northeast lies a designated chemical pesticide container area which is in good condition. The access routes in the site are lined with strewn waste. Bulky metals and tires are littered throughout the site and mixed with burned and burning waste.

Overall the site location is good, however site operation and upkeep is poor, with the site area poorly utilized.

4.1.5 PHYSIOGRAPHY

The site area is located in the Lake Agassiz basin of the Manitoba lowlands and shows little to no relief in the area. To the north the Boyne River incised two to three metres into its alluvial channel bed, meanders through the area toward the east. Drainage around the site is towards the Boyne River via drainage ditches.

The terrain is mainly open prairie utilized as agricultural fields with no trees in the site area.

4.1.5 DRILLING AND SAMPLING

A sampling program was not undertaken at this site, while a drilling program was undertaken to confirm geologic data (see geologic logs in Appendix B).

4.2 GEOLOGIC DATA

4.2.1 GEOLOGIC SETTING

The site area is located on Lake Agassiz basin Lacustrine deposits. These deposits overlie previously deposited glacial till which in turn overlies bedrock.

The Boyne River to the north which is incised below the surrounding grade has reworked the sediments to form alluvium.

Sand and gravel units do not exist in the basin clays and only as minor pockets in the clay till. As a result the sediments are low in overall permeability. Rainfall is absorbed by the topsoil and transpires, the excess is drained through drainage ditches to the Boyne River. (See Figure 4.3 and 4.4 in Appendix A).

4.2.2 BEDROCK

At a depth of 50 metres, bedrock beneath the site consists of interbedded shale and sandstone, and interbedded limestone and gypsum of the Jurassic age.

4.2.3 OVERBURDEN

Two distinct units form approximately 50 metres of overburden overlying bedrock. The lower unit consists of 35 metres of dense calcareous till. The upper 15 metres consists of lacustrine deposits. This upper unit consists of three layers, the lower layer consists of dense clay grading to the middle layer of siltier clay with the upper layer consisting of a thin silty sand cover.

4.2.4 GEOHYDROLOGY

Two major type of aquifers, both confined, exist in this area. The lower aquifer consists of saturated fractured bedrock which is confined by the till layer above. The upper confined aquifers consist of gravel and sand lenses in the till, which are confined by the lacustrine silty clay which overlies it.

Groundwater flow is easterly.

4.3 ENVIRONMENTAL INTERPRETATION AND ASSESSMENT

4.3.1 LEACHATE HYDROLOGY

The majority of leachate generated at this site is produced during times of high snowmelt or precipitation. Leachate migration is via surficial runoff to drainage ditches which run to the nearby Boyne River, as it is unlikely that leachate migrates more than a few metres into the topsoil.

Due to the impermeable lacustrine sediments which confine the aquifers in the area, potential of aquifer contamination is low. As well, the majority of cations in the leachate will be absorbed in the organic-clay soil before entering surface waters.

4.3.2 METHANE

Based on the amount of waste deposited at this site an estimated 7 million cubic metres of methane gas per year may be generated. Since the waste is burned before burial the actual suspected quantity of methane gas generated will only be a fraction of the estimate. The migration distance of any methane gas produced should be less than 20 metres based on soil and burial conditions.

4.3.3 WATER QUALITY

Aquifer water quality in this area will not be affected by leachates due to the thick impermeable confining layer.

Water quality of the Boyne River will not be affected noticeably due to the attenuating properties of the clayey topsoil in the area.

4.3.4 CONCLUSION

Potential of ground and surface water contamination by the site is low. The site location is good as the nearest resident is located 400 metres away. The site condition is poor due to the lack of organization of the site dumping areas, as seen by waste being strewn through the access ways and site area in general. Also bulky metallic waste and tires are seen mixed and burning with common municipal waste, and exposed waste is left in piles throughout the active area without being centrally collected and burned.

4.3.5 RECOMMENDATIONS

1. Strewn waste along the access road should be cleaned up.
2. A bulky metallic waste disposal area should be established.
3. Tires should not be burned.
4. Exposed wastes should be collected into one area and covered.
5. One central dumping and burning area should be established, and signs posted.
6. Fill covering at more frequent intervals should be implemented.

APPENDIX A

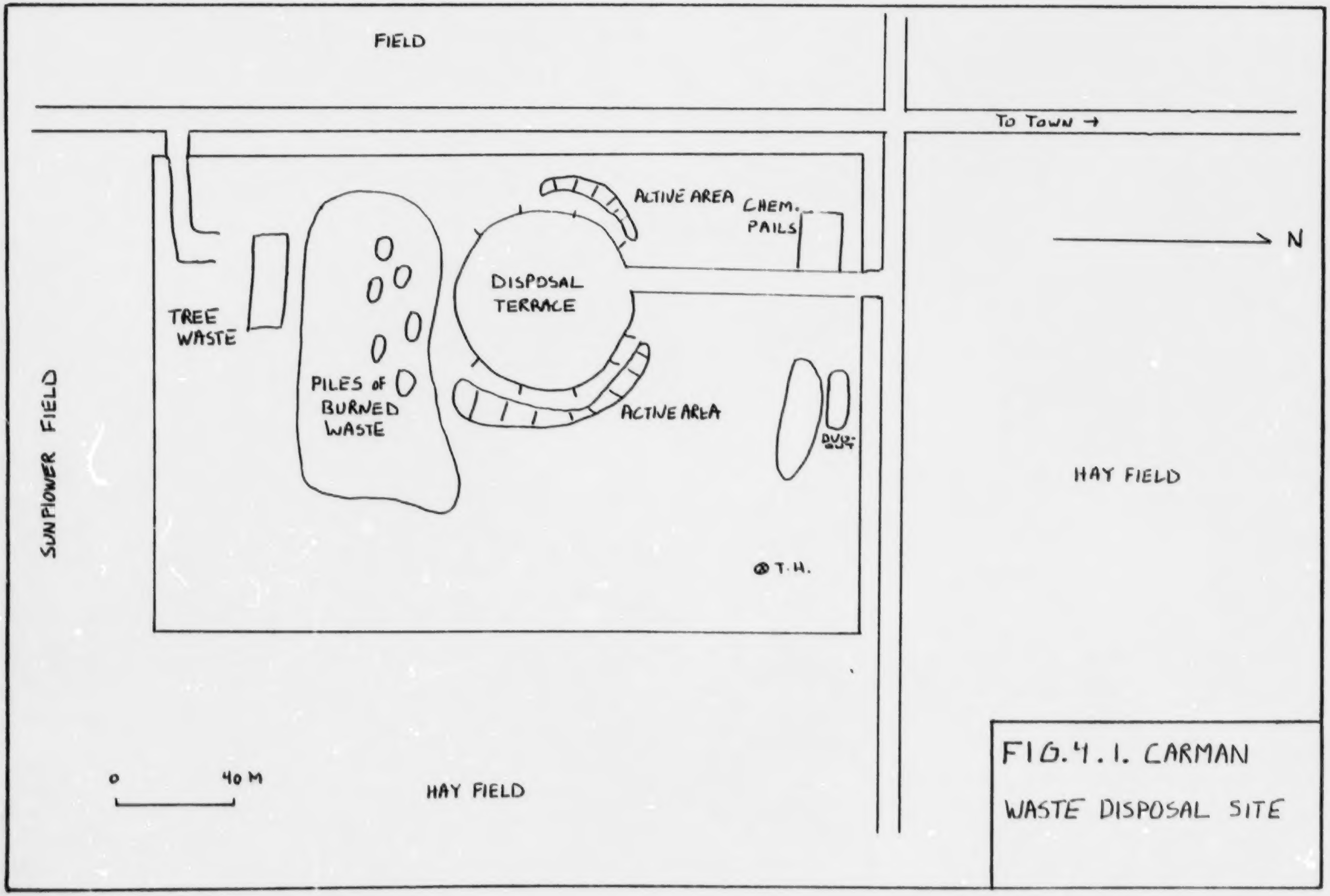

FIELD
TO TOWN →
N
ACTIVE AREA
CHEM. PAILS
DISPOSAL TERRACE
TREE WASTE
PILES OF BURNED WASTE
ACTIVE AREA
DUG-OUT
HAY FIELD
⊗ T.H.
SUNFLOWER FIELD
0
40 M
HAY FIELD

FIG. 4.1. CARMAN WASTE DISPOSAL SITE

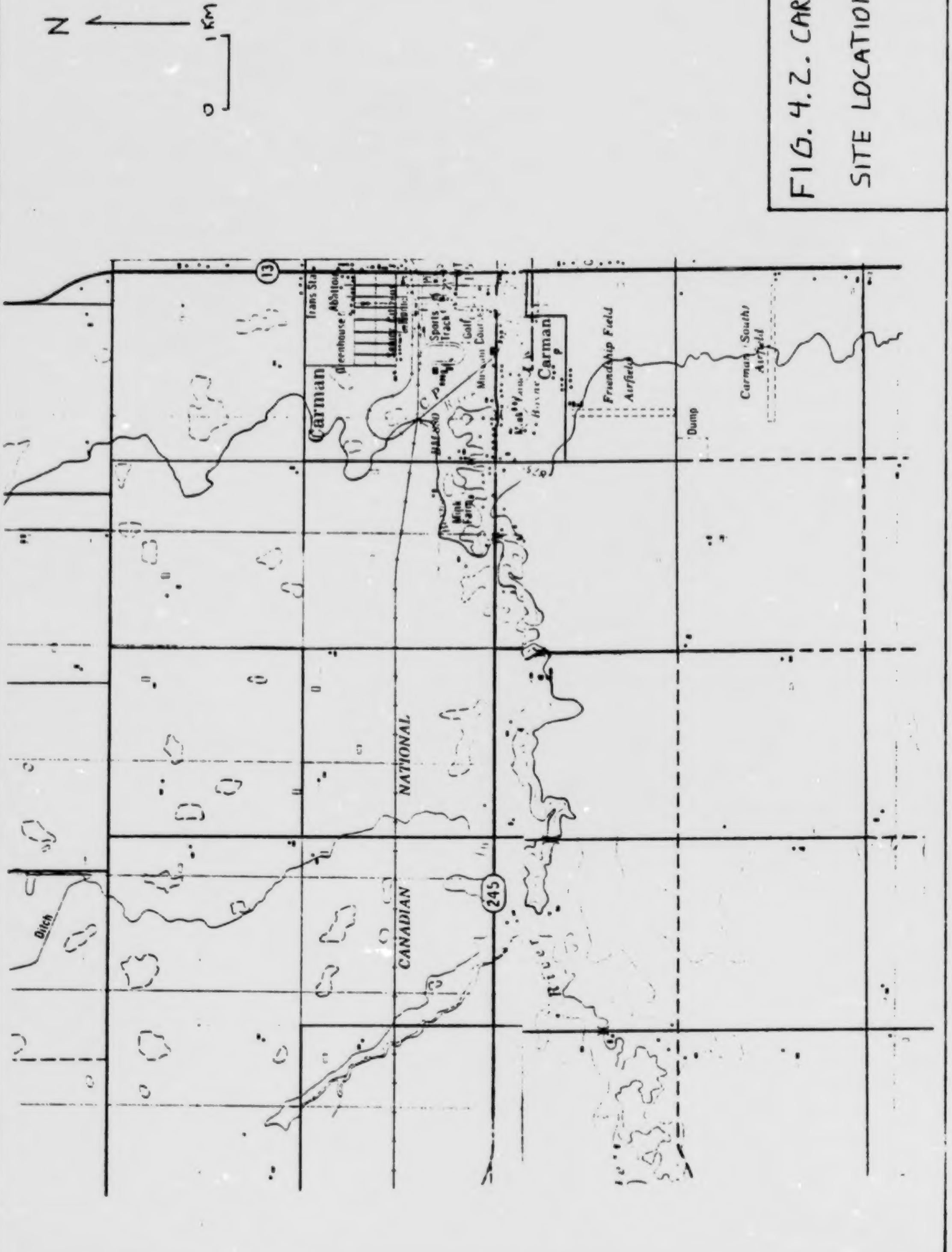

N
0
1 KM
13
Trans Sta
Greenhouse
Addition
Sports Track
Golf Course
Museum
Carman
Carman
C.P.R.
Mink Farm
Friendship Field Airfield
Carman South Airfield
Dump
CANADIAN NATIONAL
245
River
Ditch

FIG. 4.2. CARMAN SITE LOCATION MAP

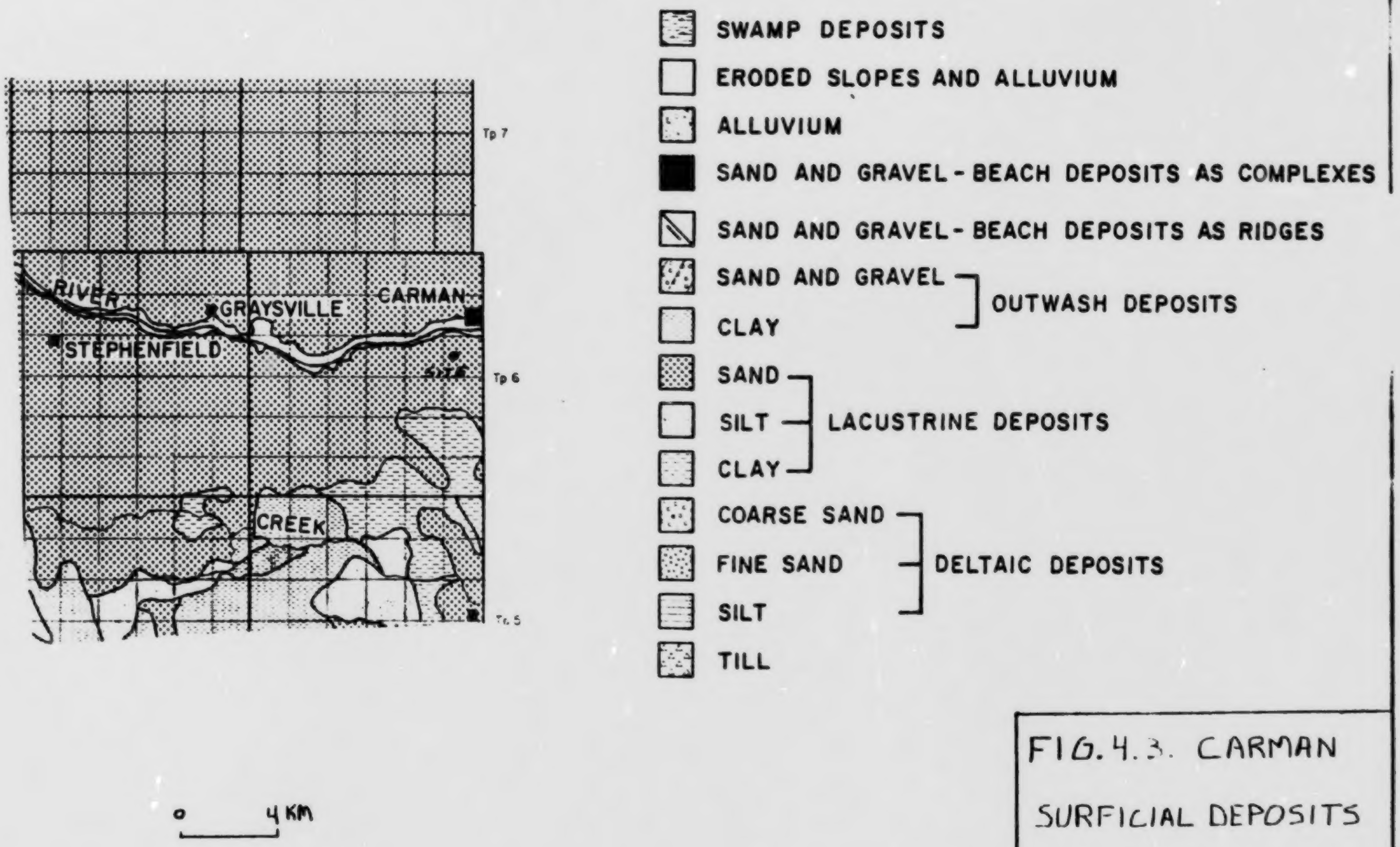

Tp 7
Tp 6
Tp 5
RIVER
GRAYSVILLE
CARMAN
STEPHENFIELD
SITE
CREEK
SWAMP DEPOSITS
ERODED SLOPES AND ALLUVIUM
ALLUVIUM
SAND AND GRAVEL - BEACH DEPOSITS AS COMPLEXES
SAND AND GRAVEL - BEACH DEPOSITS AS RIDGES
SAND AND GRAVEL
CLAY
OUTWASH DEPOSITS
SAND
SILT
CLAY
LACUSTRINE DEPOSITS
COARSE SAND
FINE SAND
SILT
DELTAIC DEPOSITS
TILL
0
4 KM

FIG. 4.3. CARMAN SURFICIAL DEPOSITS MAP

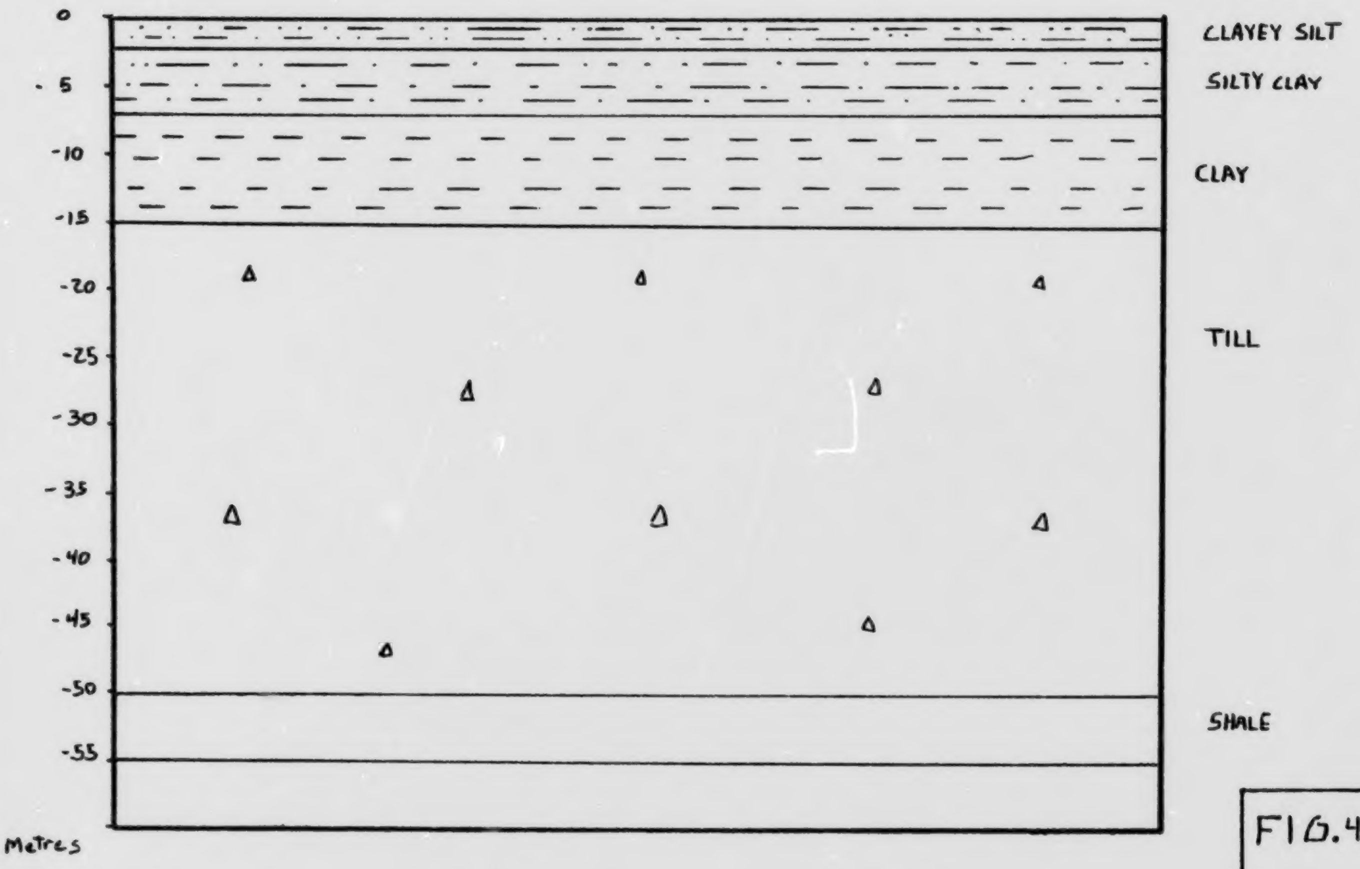

0
- 5
-10
-15
-20
-25
-30
-35
-40
-45
-50
-55
Metres
CLAYEY SILT
SILTY CLAY
CLAY
TILL
SHALE

FIG.4.4. CARMAN GEOLOGIC CROSS SECTION

APPENDIX B

GEOLOGIC LOG

LOCATION: Carman Waste Disposal Site

TEST HOLE IDENTIFICATION: T.H. 1

DATE: July 16, 1985

TOTAL DEPTH: 11.5 Metres

WATER TABLE: 3.9 Metres

TYPE OF CASING: N/A

TYPE OF SCREEN: N/A

DEPTH (METRES)	DESCRIPTION
0 - 1.0	silty sand topsoil
1.0 - 3.0	clay
3.0 - 8.0	silty clay
8.0 - 11.5	clay

CHAPTER - FIVE -

COWAN

L. G. D. OF MOUNTAIN

NW 14-35-23W

5 COWAN WASTE DISPOSAL SITE

5.1 RECONNAISSANCE DATA

5.1.1 LOCATION

The Community of Cowan is located in the L.G.D. of Mountain located approximately 45 kilometres east of Swan River along P.T.H. 10. The waste disposal site is located approximately 3 kilometres south of the community on Section NW 14-35-23W (see Figures 5.1 and 5.2 in Appendix A).

5.1.2 BACKGROUND

This waste disposal site has been operating in its current location for over ten years. In 1977 the site was registered with the Province as an existing waste disposal ground. Present records show that this site serves approximately 300 people. Primarily municipal waste from the Community of Cowan and household waste from surrounding rural areas are deposited at this site. All wastes including household, agricultural chemical pails and bulky metals are deposited in a water filled trench and then partially burned. Rural and town residents derive water from either the shallow surficial aquifers or from the deep bedrock aquifer in the area.

5.1.3 SITE CONDITIONS

During the site inspection on September 11, 1985, several observations were made. The site is located directly south of the Community and access to the site is via a 120 metre long, all weather gravel road, running west from P.T.H. 10.

The site covers an area of 90 metres by 70 metres and is located in a gravel deposit which is still utilized as a gravel pit. The active area consists of one trench into which all waste is deposited. The trench measures approximately 1 metre deep, 3 metres wide and 15 metres long and is filled with water to approximately .3 metres below grade. This localized gravel deposit is also a shallow surficial aquifer. Since the waste is deposited in the water, little burning can be undertaken at this site. The area is not fenced, and there are three ponds located on the site and several creeks located close to the site. There are no residences located within several kilometres. Site location is poor as waste is deposited directly into an unconfined surficial aquifer.

5.1.4 PHYSIOGRAPHY

The site is located at the boundary between the Manitoba uplands, Duck Mountain region and the Manitoba lowland, Interlake - Westlake plain, on the Westlake plain level. The area gently slopes to the east with little or no surface runoff, indicating the soil in the site area is very permeable. At points topography dips below groundwater level as seen by the presence of three ponds on the site. The site is located in a forested area with little open land in the region. The ponds are hydrologically connected to several creeks in the area.

5.1.5 DRILLING AND SAMPLING

A drilling program was undertaken at this site and four test holes were drilled to confirm geologic conditions. Three water samples were taken, one from the trench and two from the nearby ponds. Drill logs can be found in Appendix C, Analytical Results of the water samples can be found in Appendix B.

5.2 GEOLOGIC DATA

5.2.1 GEOLOGIC SETTING

The area is located on a nearshore deposit, consisting of highly permeable coarse sand and gravel, which overlies calcareous till. The till overlying bedrock consists of generally gravely clay exhibiting variable permeabilities. (See Figure 5.3 and 5.4 in Appendix A).

5.2.2 BEDROCK

At a depth of approximately 40 metres shale of the Cretaceous Period forms the bedrock.

5.2.3 OVERBURDEN

Approximately 40 metres of overburden overlies bedrock in this area. The overburden consists of two units. The lower unit, highly calcareous till, approximately 30 metres thick, consists of impermeable clay with limestone fragments, with some sand and gravel lenses. The upper unit, approximately 10 metres thick consists of highly permeable nearshore deposits of sand and gravel.

5.2.4 GEOHYDROLOGY

Two major aquifers exist in the area. The deep bedrock shale aquifer is confined by the till layer, and is used in the area as the main water supply.

The second aquifer in the area consists of surficial unconfined gravel and sand deposits.

In the site area a creek runs south to north and is likely hydrologically connected to ground water in the gravel pit. Sewage was found in a test hole north of the waste trench, which indicated a northerly groundwater flow direction.

5.3 ENVIRONMENTAL INTERPRETATION AND ASSESSMENT

5.3.1 LEACHATE HYDROLOGY

Leachates enter the groundwater directly from the waste trench, since the trench penetrates the water table. Production of leachates is continuous, independent of precipitation. Also sewage disposal of the trench adds to the degree of groundwater contamination.

The bedrock aquifer at depth is not likely affected by leachates due to the low permeability till layer which separates the bedrock from the surficial aquifer.

5.3.2 METHANE

Based on the amount of waste deposited at this site, an estimated 200,000 cubic meters of methane gas may be produced per year. Since a portion of the waste is burned before burial, the actual suspected quantity of methane gas generated will only be a fraction of the above estimate. Migration of any gas generated should be limited to approximately 3 metres based on soil conditions.

5.3.3 WATER QUALITY

Water Quality Analysis of three samples, one upstream, one at the contamination source and one downstream were undertaken. Analysis of the upstream, Sample #1, shows excellent quality water with very low concentrations of dissolved solids and ions. Analysis of the water in the waste trench, Sample #3, the source of the contamination shows elevated dissolved solids levels, elevated metal ion concentrations, and elevated chemical oxygen demand, with a very high fecal and total coliform levels. Analysis of the downstream pond, Sample #2, show slightly higher than upstream quality parameter levels of dissolved solids, and higher fecal coliform levels.

5.3.4 CONCLUSION

Based on the available data to date this site poses a moderate impact on the environment. Drilling tests and water samples show contamination of the shallow surficial aquifer is occurring. The contamination is migrating off site in the direction of the nearby creek. Overall site location is poor due to the geologic conditions. Site operation is good as the site is well kept.

5.3.5 RECOMMENDATIONS

1. Steps should be taken by the L.G.D. to relocate this site.
2. In the interim:
    - a) waste should be deposited and fill covered above grade.
    - b) sewage should not be disposed at this site unless a proper pit is utilized.
    - c) a separate bulky metallic waste pile should be implemented.
3. Sampling of the nearby creek should be conducted.

APPENDIX A

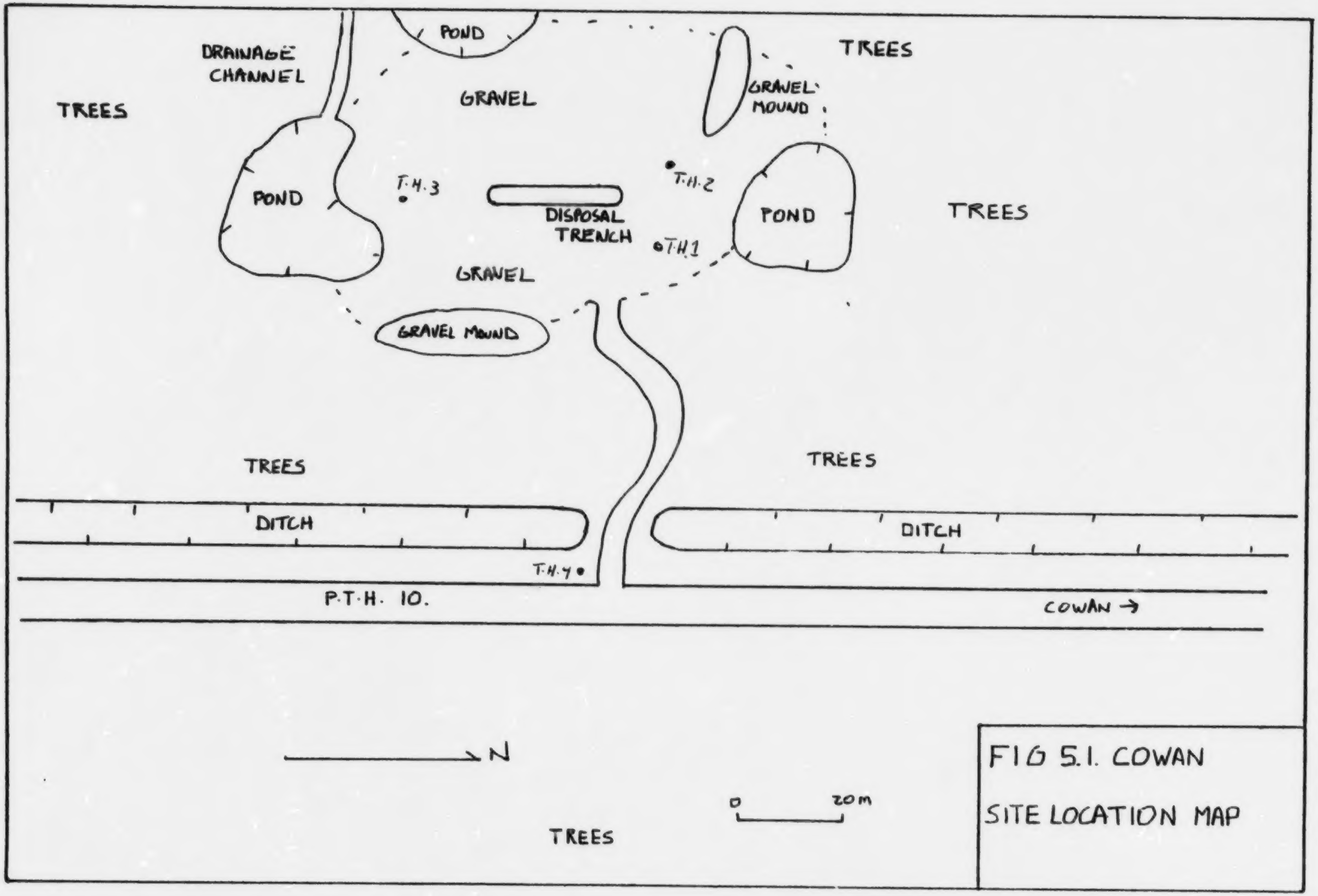

TREES
DRAINAGE CHANNEL
POND
GRAVEL
TREES
GRAVEL MOUND
T.H.3
POND
T.H.2
DISPOSAL TRENCH
POND
TREES
T.H.1
GRAVEL
GRAVEL MOUND
TREES
TREES
DITCH
DITCH
T.H.4
P.T.H. 10.
COWAN →
N
0
20m
TREES

FIG 5.1. COWAN
SITE LOCATION MAP

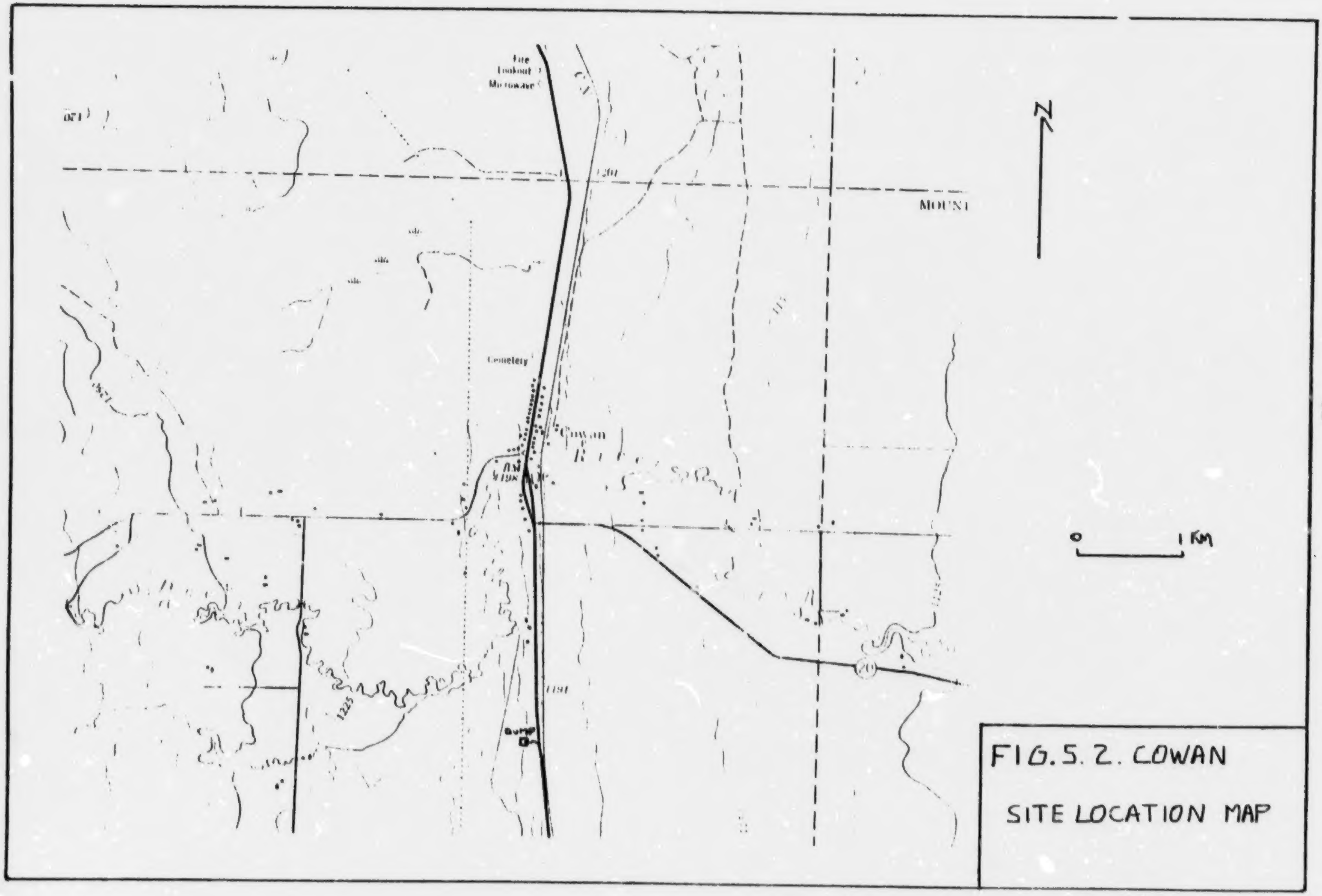

N
0
1 KM
Fire
Lookout
Microwave
CN
1201
MOUNT
Cemetery
Cowan
1198
1191
1225
20
Dump

FIG.5.2. COWAN

SITE LOCATION MAP

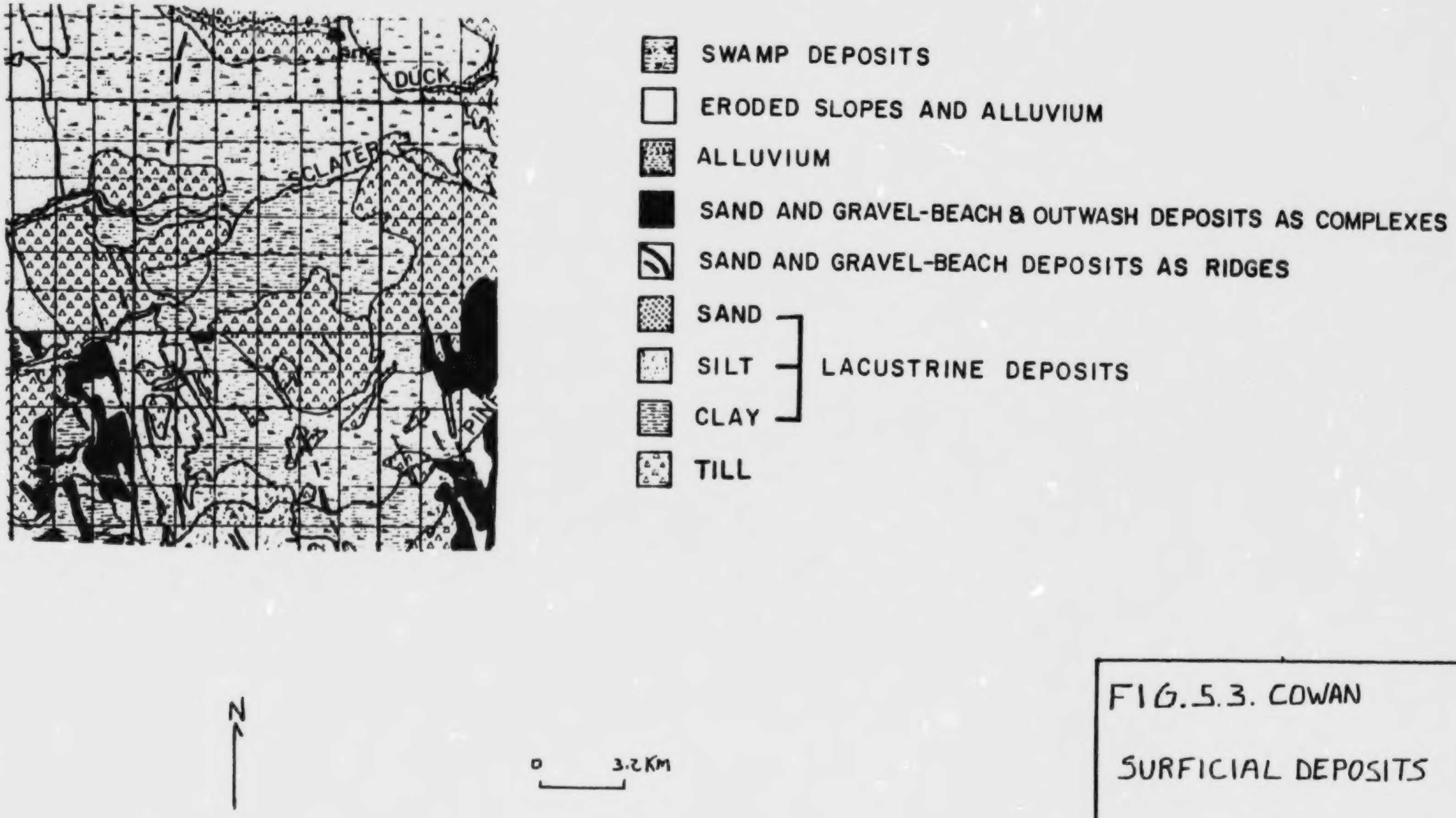

SITE
DUCK
SCLATER
PINE
▨ SWAMP DEPOSITS
☐ ERODED SLOPES AND ALLUVIUM
▨ ALLUVIUM
■ SAND AND GRAVEL-BEACH & OUTWASH DEPOSITS AS COMPLEXES
▨ SAND AND GRAVEL-BEACH DEPOSITS AS RIDGES
▨ SAND
▨ SILT
▨ CLAY
LACUSTRINE DEPOSITS
▨ TILL
N
0
3.2KM

FIG. 5.3. COWAN

SURFICIAL DEPOSITS

MAP

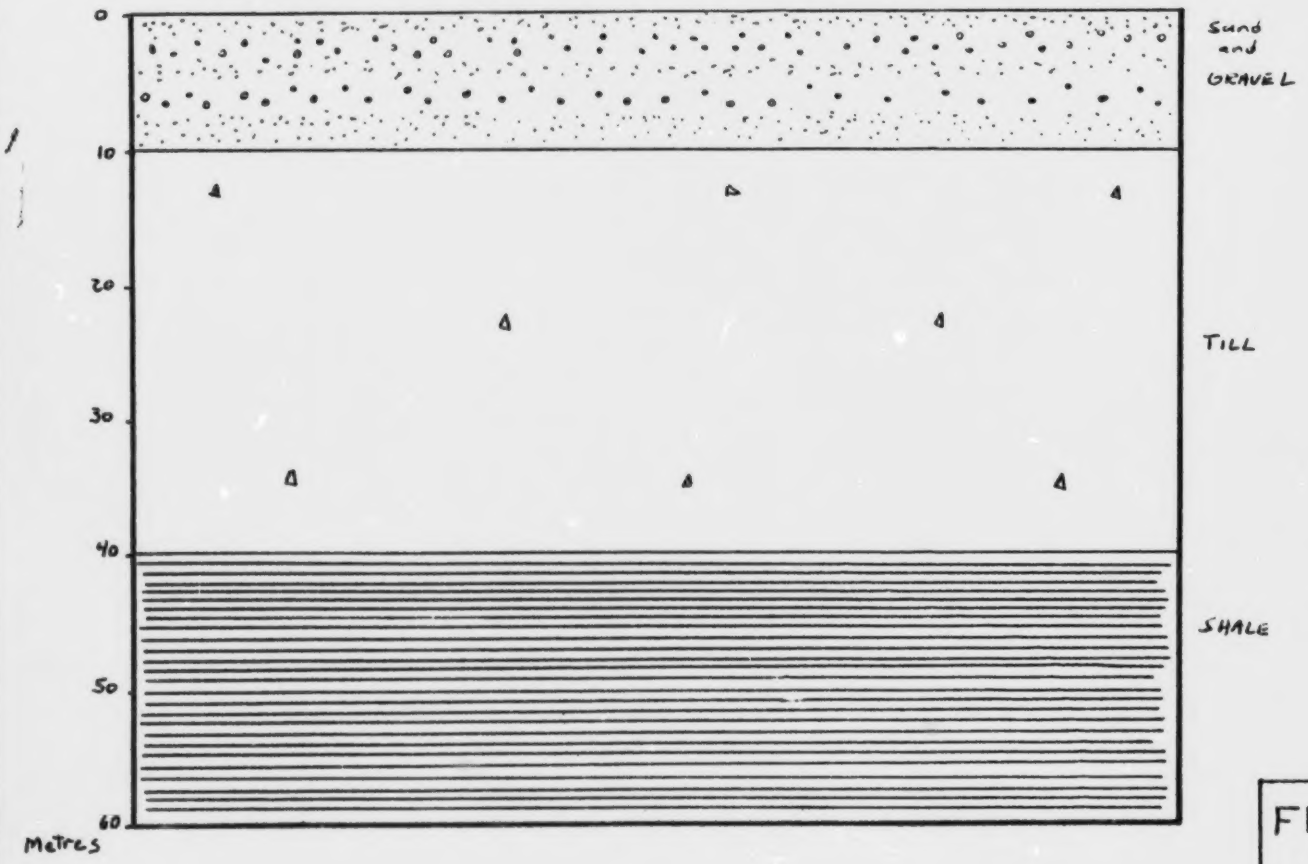

0
10
20
30
40
50
60
Metres
Sand and GRAVEL
TILL
SHALE

FIG. 5.4. COWAN GEOLOGIC CROSS SECTION

APPENDIX B

WATER QUALITY ANALYSIS

LOCATION: Cowan
SAMPLE #: Surface Sample One
DATE: September 11, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	359	umho/cm
Residue Total	230	mg/l
Residue Filterable	220	mg/l
Residue Non Filterable	8	mg/l
pH	8.20	units
Alkalinity Total ($CaCO_3$)	186.	mg/l
Alkalinity (HCO_3)	227.	mg/l
Alkalinity (CO_3)	0	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	<.001	mg/l
Cadmium (Ext)	<.001	mg/l
Copper (Ext)	<.01	mg/l
Lead (Ext)	<.005	mg/l
Nickel (Ext)	<.005	mg/l
Zinc (Ext)	<.01	mg/l
Chromium (Ext)	<.005	mg/l
Calcium (Ext)	40.7	mg/l
Magnesium (Ext)	22.4	mg/l
Hardness ($CaCO_3$)	194	mg/l
Manganese (Ext)	.08	mg/l
Iron (Ext)	.46	mg/l
Potassium (Ext)	<5.00	mg/l
Sodium	7.10	mg/l
COD	44	mg/l
TOC	-	mg/l
Turbidity	3.5	NTU
CN (Total)	<.02	mg/l
Kjeldhal, Total, -N	.80	mg/l
NH_3-N. Sol.	<.02	mg/l
NO_3-NO_2-N	<.01	mg/l
Phosphate Total	.03	mg/l
Chloride	3.0	mg/l
Sulphate	5.8	mg/l
Coliform Group	1500+	per 100 ml
Fecal Coliform	0	per 100 ml

WATER QUALITY ANALYSIS

LOCATION: Cowan
SAMPLE #: Surface Sample Two
DATE: September 11, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	435	umho/cm
Residue Total	290	mg/l
Residue Filterable	270	mg/l
Residue Non Filterable	22	mg/l
pH	7.95	units
Alkalinity Total ($CaCO_3$)	236	mg/l
Alkalinity (HCO_3)	288	mg/l
Alkalinity (CO_3)	0	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	<.001	mg/l
Cadmium (Ext)	<.001	mg/l
Copper (Ext)	<.01	mg/l
Lead (Ext)	<.005	mg/l
Nickel (Ext)	<.005	mg/l
Zinc (Ext)	<.01	mg/l
Chromium (Ext)	<.005	mg/l
Calcium (Ext)	55.1	mg/l
Magnesium (Ext)	22.5	mg/l
Hardness ($CaCO_3$)	230	mg/l
Manganese (Ext)	.04	mg/l
Iron (Ext)	.44	mg/l
Potassium (Ext)	<5.00	mg/l
Sodium	5.0	mg/l
COD	34	mg/l
TOC	-	mg/l
Turbidity	8.5	NTU
CN (Total)	<.02	mg/l
Kjeldhal, Total, -N	.60	mg/l
NH_3-N. Sol.	<.02	mg/l
NO_3-NO_2-N	<.01	mg/l
Phosphate Total	.025	mg/l
Chloride	<2.0	mg/l
Sulphate	56.	mg/l
Coliform Group	1100	per 100 ml
Fecal Coliform	4	per 100 ml

WATER QUALITY ANALYSIS

LOCATION: Cowan
SAMPLE #: Surface Sample Three
DATE: September 11, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	1060	umho/cm
Residue Total	910	mg/l
Residue Filterable	860	mg/l
Residue Non Filterable	54.	mg/l
pH	6.40	units
Alkalinity Total ($CaCO_3$)	416	mg/l
Alkalinity (HCO_3)	502	mg/l
Alkalinity (CO_3)	0	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	.001	mg/l
Cadmium (Ext)	.003	mg/l
Copper (Ext)	.01	mg/l
Lead (Ext)	<.005	mg/l
Nickel (Ext)	<.005	mg/l
Zinc (Ext)	.75	mg/l
Chromium (Ext)	.013	mg/l
Calcium (Ext)	116	mg/l
Magnesium (Ext)	33.7	mg/l
Hardness ($CaCO_3$)	430	mg/l
Manganese (Ext)	.97	mg/l
Iron (Ext)	9.15	mg/l
Potassium (Ext)	24.0	mg/l
Sodium	42.4	mg/l
COD	790	mg/l
TOC	-	mg/l
Turbidity	10	NTU
CN (Total)	<.02	mg/l
Kjeldhal, Total, -N	17.0	mg/l
NH_3-N. Sol.	11.0	mg/l
NO_3-NO_2-N	<.01	mg/l
Phosphate Total	3.2	mg/l
Chloride	48	mg/l
Sulphate	13	mg/l
Coliform Group	150000+	per 100 ml
Fecal Coliform	46000.	per 100 ml

APPENDIX C

GEOLOGIC LOG

LOCATION: Cowan Waste Disposal Site

TEST HOLE IDENTIFICATION: T.H. 1

DATE: Oct. 27, 1985

TOTAL DEPTH: 13.63 Metres

WATER TABLE: 1.81 Metres

TYPE OF CASING: N/A

TYPE OF SCREEN: N/A

DEPTH (METRES)	DESCRIPTION
0 - 1.81	sandy gravel
1.81 - 2.15	sand, med, wet
2.15 - 3.93	fine brown sand, wet
3.93 - 4.54	sandy dirty gravel, wet
4.54 - 6.06	sandy gravel, wet
6.06 - 7.27	fine sand, wet
7.27 - 8.48	silty organic clay, wet
8.48 - 9.69	grey sand and gravel, organic, wet
9.69 - 10.60	grey clay, wet
10.60 - 13.63	silty clay, soft, creamy, limestone till, moist.

GEOLOGIC LOG

LOCATION: Cowan Waste Disposal Site

TEST HOLE IDENTIFICATION: T.H. 2

DATE: Oct. 27, 1985

TOTAL DEPTH: 10.60 Metres

WATER TABLE: .90 Metres

TYPE OF CASING: N/A

TYPE OF SCREEN: N/A

DEPTH (METRES)	DESCRIPTION
0 - 1.51	coarse sand and gravel, wet
1.51 - 3.63	grey sand, fine, wet
3.63 - 5.45	gravel, med., wet
5.45 - 8.48	grey sand, fine, wet
8.48 - 10.30	clay, moist
10.30 - 10.60	silty clay, limestone till, moist.

GEOLOGIC LOG

LOCATION: Cowan Waste Disposal Site

TEST HOLE IDENTIFICATION: T.H. 3

DATE: Oct. 27, 1985

TOTAL DEPTH: 12.12 Metres

WATER TABLE: .60 Metres

TYPE OF CASING: N/A

TYPE OF SCREEN: N/A

DEPTH (METRES)	DESCRIPTION
0 - .60	gravel
.60 - 3.0	grey sand, fine, wet
3.0 - 7.57	med. grey sand, wet
7.57 - 10.60	clay, moist
10.60 - 12.12	silty clay limestone till, dry.

GEOLOGIC LOG

LOCATION: Cowan Waste Disposal Site

TEST HOLE IDENTIFICATION: T.H. 4

DATE: Oct. 27, 1985

TOTAL DEPTH: 15.15 Metres

WATER TABLE: 1.51 Metres

TYPE OF CASING: N/A

TYPE OF SCREEN: N/A

DEPTH (METRES)	DESCRIPTION
0 - 1.51	sandy gravel
1.51 - 5.45	sandy gravel, more sand then above, wet
5.45 - 9.09	grey sand, fine, wet
9.09 - 10.0	clay, dry
10.0 - 10.60	dirty sand and gravel, wet
10.60 - 12.12	dirty sand with clay, wet
12.12 - 15.15	clayey dry till, grey.

CHAPTER - SIX -

ELKHORN

R.M. OF WALLACE

NW 3-12-28W

6 ELKHORN WASTE DISPOSAL SITE

6.1 RECONNAISSANCE DATA

6.1.1 LOCATION

The Village of Elkhorn is located approximately 30 kilometres west of Virden along the Trans Canada Highway. The waste disposal site is located 1.3 kilometres north of the Village on Section NW 3-12-28W (see Figures 6.1 and 6.2 in Appendix A).

6.1.2 BACKGROUND

This waste disposal site has been operating in its present location for over ten years. In 1977, the site was registered with the Province as an existing waste disposal ground. Current records show that this site serves approximately 750 people. Primarily municipal waste from the Village of Elkhorn and household waste from surrounding rural areas is deposited at this site. An open dumping and burning method is used to dispose of waste. Area water supply is derived from shallow aquifers located in the sand or gravel deposits.

6.1.3 SITE CONDITIONS

During the site inspection on September 4, 1985, several observations were made. The site is located directly off of a section road running east west and is approximately 1.3 kilometres north of the Village. The site is approximately 40 metres by 80 metres in size, the active dumping area is approximately 30 metres by 40 metres, with one trench approximately 5 m by 3 m by 2 m deep.

Waste is deposited in piles throughout the site and burned. Almost the entire active area is littered with burned waste piles that have not been filled covered. The current trench is filled with water and not being used. The site is not fenced and does not have an organized bulky metallic waste pile, or an agricultural chemical container area. The nearest residence is 500 metres west. Overall the site location is good but site operation and organization can be improved.

6.1.4 PHYSIOGRAPHY

The site area is located in the Western Manitoba Uplands, in the Minnedosa-Reston till plain. The region is characterized by creeks which have formed back cutting channels ranging from 1-3 metres below grade into the surrounding till to provide drainage from the western highlands into the moderately lower prairie level which connects Turtle and Riding Mountains.

The area is further characterized by the abundance of intermittent lakes and ponds, and the occasional gravel pit. Land use in the area is strictly agricultural with no forested land.

6.1.5 DRILLING AND SAMPLING

A drilling and sampling program was undertaken at this site. One monitoring well was installed and two test holes drilled (see Appendix C for well logs). Two water samples were taken, one from the monitoring well and a surficial sample from a drainage ditch on the site (see Analytical Results, Appendix B).

6.2 GEOLOGIC DATA

6.2.1 GEOLOGIC SETTING

The site area is situated on the edge of a Glaciofluvial depositional environment, in an ice marginal deposit area. The area is characterized by late glacial valley till deposits, consisting of interbedded gravel and sand lenses. The site itself is found on the border of this area and is located on glacial till.

6.2.2 BEDROCK

At a depth of approximately 9 metres hard grey siliceous shale of the Upper Cretaceous Period underlies this site.

6.2.3 OVERBURDEN

The overburden in the site area consists of impermeable clay till approximately 9 metres deep with a sand lense underlying the west half of the site. This sand lense is confined in the site area with 2-3 metres of impermeable clay, into which a trench has been dug. Precipitation has collected in the trench and is currently full. The recharge area for this sand lense is unknown.

6.2.4 GEOHYDROLOGY

The intermittent sand and gravel lenses form the only aquifer water sources in the area, while many surficial dugouts, intermittent ponds and lakes can be found.

6.3 ENVIRONMENTAL INTERPRETATION AND ASSESSMENT

6.3.1 LEACHATE HYDROLOGY

Leachates are generated at this site during times of high precipitation, and snow melt and by the waste deposited directly into the water filled trench. Drainage from the site migrates north to ditches and flows east, where it collects in depressions as intermittent ponds. The sand lense aquifer is only partially protected from leachate contamination by an overlying clay layer, as the clay layer in thin leachate contamination of the sand lense is suspected.

6.3.2 METHANE

Based on the amount of waste deposited at this site, an estimated 2.0 million cubic metres of methane gas may be produced per year. Since the majority of waste is burned before burial, the actual quantity of methane gas generated will be a fraction of the above estimate. The migration distance of any gas generated should be limited to approximately 30 metres based on soil conditions.

6.3.3 WATER QUALITY

The water quality analysis of the sample taken from the drainage ditch located immediately north of the site shows good quality water, which indicates no leachate is running off the site. The water quality analysis taken from the monitoring well indicates the sand lense is contaminated, with manganese, iron, nitrates, chloride and sulphate levels higher than the Canadian drinking water maximum acceptable concentrations.

6.3.4 CONCLUSION

Due to the impermeable till layer, any bedrock aquifers in the region should not be affected by the site operation. It appears that the sand lense underneath the site is contaminated. The source of the contamination is unknown; however, it is suspected that either sewage disposal on the site or cattle operations in the area may be affecting the water quality of this lense. It is suspected that no downstream wells in the area should be affected, due to the distance between the site and the nearest wells. Overall, the site location is good; however, site operational practices can be improved.

6.3.5 RECOMMENDATIONS

1. A bulky metallic waste disposal area and an agricultural chemical container disposal area should be established.
2. Steps should be taken to initiate a systematic disposal operation by:
    (a) establishing one active area;
    (b) erect signs to indicate the active area.
3. If the trench located at the south end of the site is not being utilized, it should be filled in and covered.

APPENDIX A

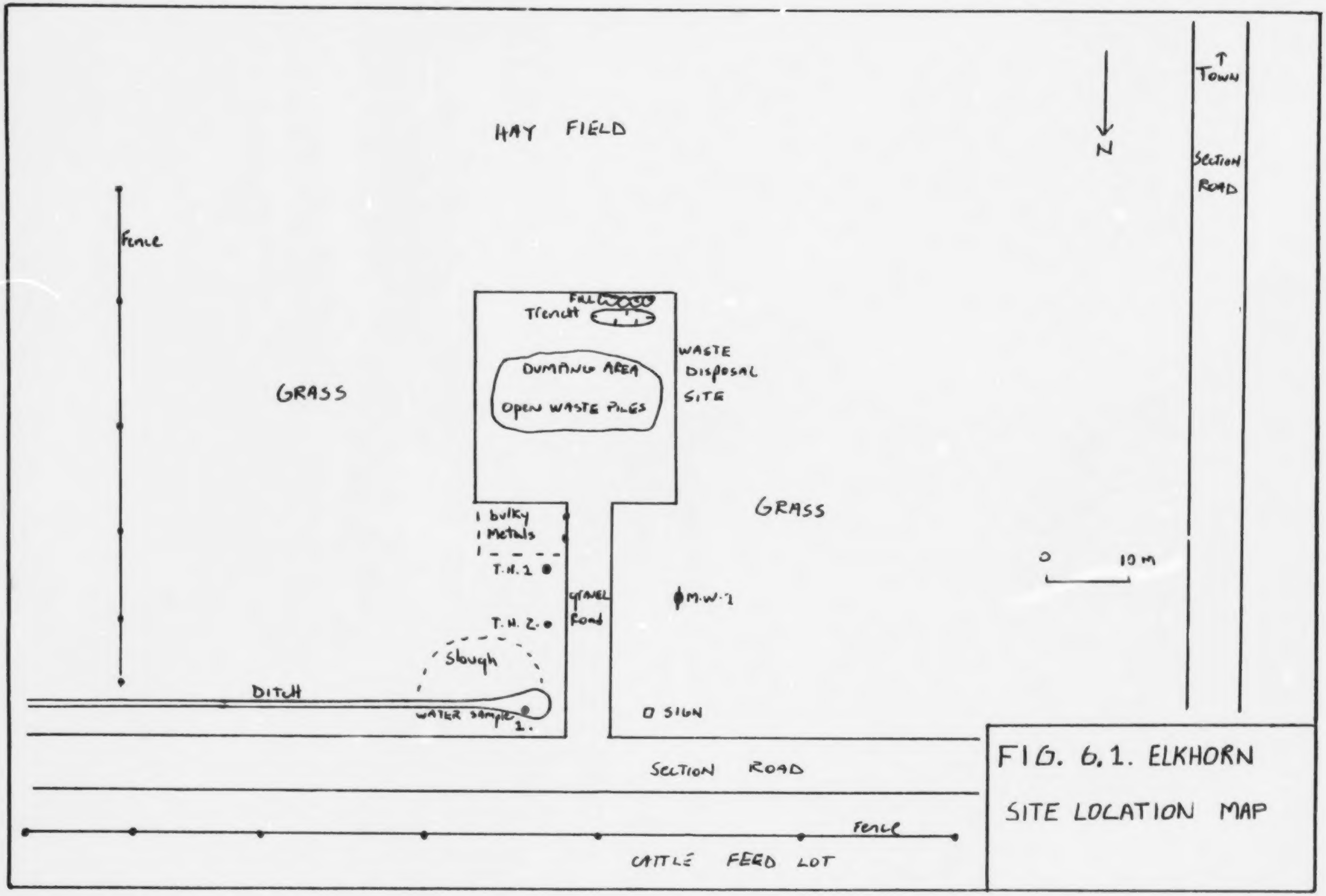

HAY FIELD
N
Town
Section Road
Fence
Fill
Trench
Dumping Area
Open Waste Piles
Waste Disposal Site
GRASS
GRASS
bulky Metals
T.H.1
T.H.2
Gravel Road
M.W.1
0 10 m
Slough
Ditch
Water sample 1.
Sign
Section Road
Fence
Cattle Feed Lot

FIG. 6.1. ELKHORN SITE LOCATION MAP

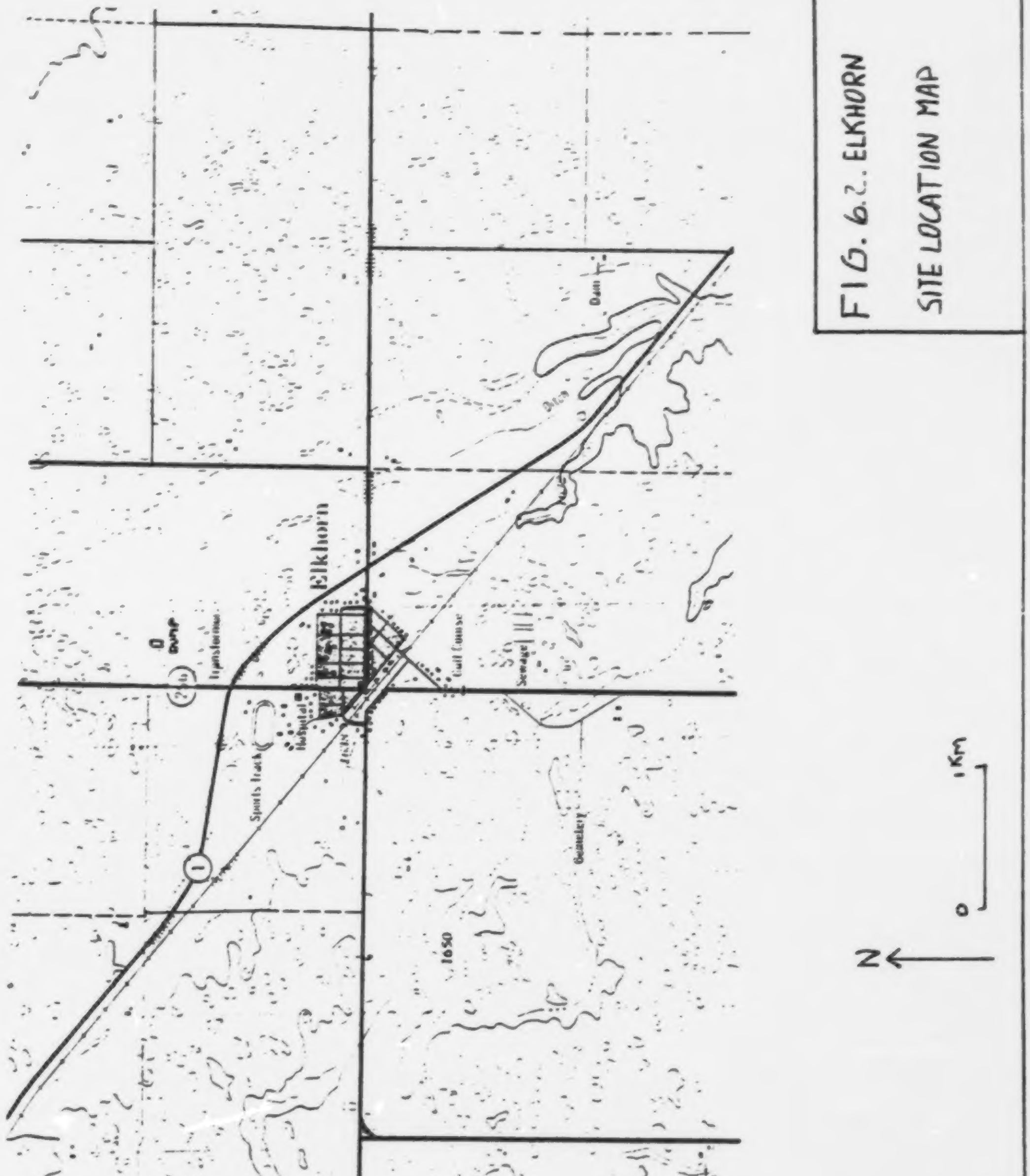

Elkhorn
Dump
Transformer
Hospital
Sports track
Golf Course
Sewage
Cemetery
Ditch
Dam
1650
1675
1674
Gravel Pit
1
256
0
1Km
N

FIG. 6.2. ELKHORN
SITE LOCATION MAP

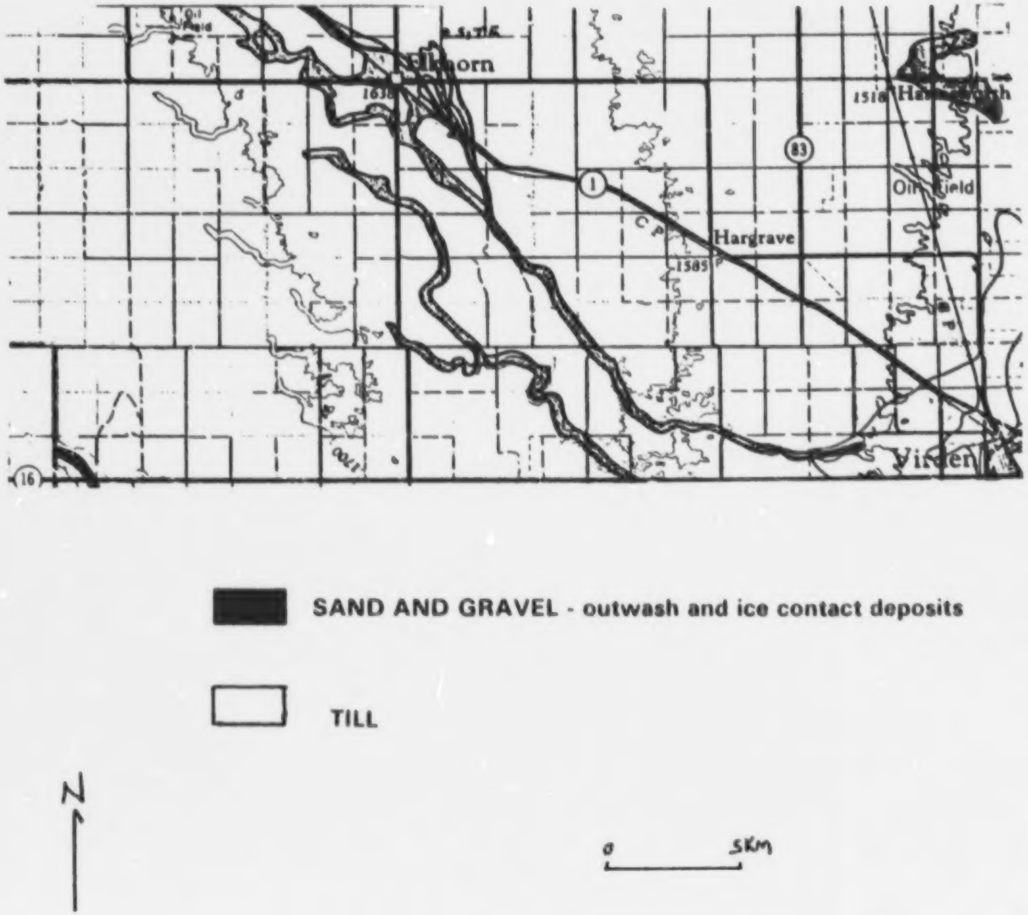

Elkhorn
1638
1
83
Hargrave
1585
C P
1518
Oil Field
Virden
16
SAND AND GRAVEL - outwash and ice contact deposits
TILL
N
0
5KM

FIG. 6.3. ELKHORN
SURFICIAL DEPOSITS
MAP

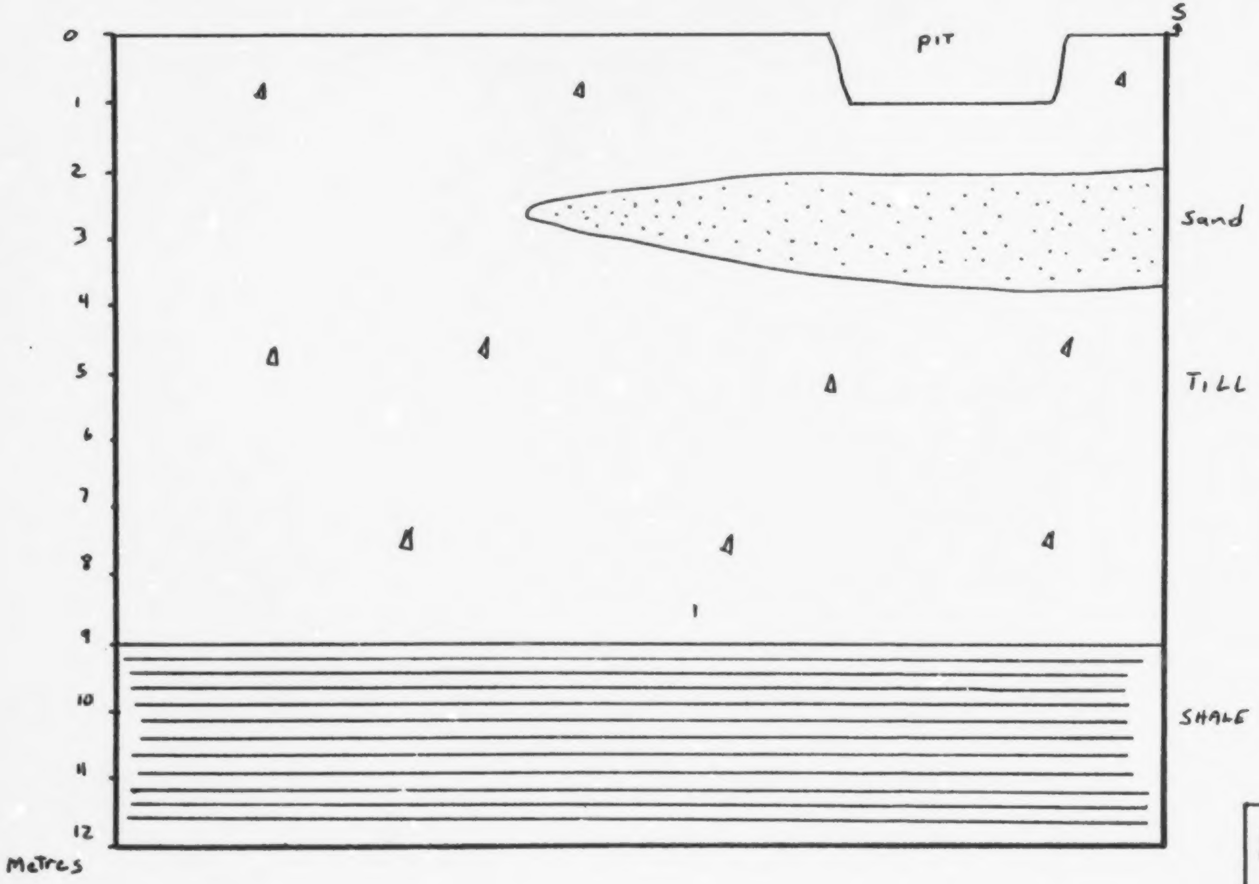

S
PIT
Sand
TILL
SHALE
0
1
2
3
4
5
6
7
8
9
10
11
12
Metres

FIG. 6.4. ELKHORN GEOLOGIC CROSS SECTION

APPENDIX B

WATER QUALITY ANALYSIS

LOCATION: Elkhorn
SAMPLE #: Monitoring Well
DATE: October 30, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	4860	umho/cm
Residue Total	5010	mg/l
Residue Filterable	3840	mg/l
Residue Non Filterable	1170	mg/l
pH	7.80	units
Alkalinity Total ($CaCO_3$)	892	mg/l
Alkalinity (HCO_3)	1088	mg/l
Alkalinity (CO_3)	0	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	.041	mg/l
Cadmium (Ext)	.001	mg/l
Copper (Ext)	.02	mg/l
Lead (Ext)	.008	mg/l
Nickel (Ext)	.024	mg/l
Zinc (Ext)	.08	mg/l
Chromium (Ext)	.014	mg/l
Calcium (Ext)	400	mg/l
Magnesium (Ext)	215	mg/l
Hardness ($CaCO_3$)	1885	mg/l
Manganese (Ext)	.52	mg/l
Iron (Ext)	7.00	mg/l
Potassium (Ext)	157.5	mg/l
Sodium	560	mg/l
COD	48	mg/l
TOC	-	mg/l
Turbidity	500	NTU
CN (Total)	-	mg/l
Kjeldhal, Total, -N	1.7	mg/l
NH_3-N. Sol.	.04	mg/l
NO_3-NO_2-N	23.	mg/l
Phosphate Total	.56	mg/l
Chloride	410	mg/l
Sulphate	1550	mg/l
Coliform Group	93	per 100 ml
Fecal Coliform	0	per 100 ml

WATER QUALITY ANALYSIS

LOCATION: Elkhorn
SAMPLE #: Surface Sample One
DATE: September 23, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	1590	umho/cm
Residue Total	1220	mg/l
Residue Filterable	1190	mg/l
Residue Non Filterable	31.	mg/l
pH	7.40	units
Alkalinity Total ($CaCO_3$)	358.	mg/l
Alkalinity (HCO_3)	437	mg/l
Alkalinity (CO_3)	0	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	.007	mg/l
Cadmium (Ext)	<.001	mg/l
Copper (Ext)	<.01	mg/l
Lead (Ext)	<.005	mg/l
Nickel (Ext)	<.005	mg/l
Zinc (Ext)	.02	mg/l
Chromium (Ext)	<.005	mg/l
Calcium (Ext)	128	mg/l
Magnesium (Ext)	65.0	mg/l
Hardness ($CaCO_3$)	588	mg/l
Manganese (Ext)	1.37	mg/l
Iron (Ext)	1.37	mg/l
Potassium (Ext)	52.5	mg/l
Sodium	128	mg/l
COD	120	mg/l
TOC	-	mg/l
Turbidity	3.0	NTU
CN (Total)	<.02	mg/l
Kjeldhal, Total, -N	1.5	mg/l
NH_3-N. Sol.	.17	mg/l
NO_3-NO_2-N	<.01	mg/l
Phosphate Total	.60	mg/l
Chloride	82	mg/l
Sulphate	400	mg/l
Coliform Group	3	per 100 ml
Fecal Coliform	0	per 100 ml

APPENDIX C

GEOLOGIC LOG

LOCATION: Elkhorn Waste Disposal Site

TEST HOLE IDENTIFICATION: M.W. 1

DATE: Oct. 26, 1985

TOTAL DEPTH: 3.63 Metres

WATER TABLE: 2.12 Metres

TYPE OF CASING: PVC 1.5 Inch Sch. 40

TYPE OF SCREEN: Polypropylene Weave

SLOTTING LENGTH: .63 - 3.63 metres

FILL MATERIAL: Silica sand, 30-40 grade

DEPTH (METRES)	DESCRIPTION
0 - 3.03	clay till
3.03 - 8.48	coarse brown sand and gravel
8.48 - 9.09	silty clay till, firm.

GEOLOGIC LOG

LOCATION: Elkhorn Waste Disposal Site

TEST HOLE IDENTIFICATION: T.H. 2

DATE: Oct. 26, 1985

TOTAL DEPTH: 6.06 Metres

WATER TABLE: N/A

TYPE OF CASING: N/A

TYPE OF SCREEN: N/A

DEPTH (METRES)	DESCRIPTION
0 - 1.51	brown clay till
1.51 - 4.84	silty clay till
4.84 - 6.06	firm blue clay till.

GEOLOGIC LOG

LOCATION: Elkhorn Waste Disposal Site

TEST HOLE IDENTIFICATION: T.H. 3

DATE: Oct. 26, 1985

TOTAL DEPTH: 7.0 Metres

WATER TABLE: N/A

TYPE OF CASING: N/A

TYPE OF SCREEN: N/A

DEPTH (METRES)	DESCRIPTION
0 - 1.51	brown clay till
1.51 - 4.54	grey clay till
4.54 - 6.36	med. grey sand, dry
6.36 - 7.0	clay till.

CHAPTER - SEVEN -

HUSAVICK ROAD

R.M. OF GIMLI

SW 26-18-3E

7 HUSAVICK ROAD WASTE DISPOSAL SITE

7.1 RECONNAISSANCE DATA

7.1.1 LOCATION

The community of Husavick is located approximately 70 kilometres north of Winnipeg along P.T.H. 8, and the waste disposal site is located approximately 6.5 kilometres west of the community of Husavick, in the R. M. of Gimli. The waste disposal site is located on Section SW 26-18-3E (see Figures 7.1 and 7.2 in Appendix A).

7.1.2 BACKGROUND

This waste disposal site has been operating in its present location for over 25 years. Currently this site is unregistered, while utilization of this site is seasonal, with a winter-summer variation of 500 to 5000 people respectively. Primarily cottage waste from Husavick and Sandy Hook, and municipal waste from surrounding rural residences is deposited at this site. A pit system for the disposal of solid waste and a two cell waste holding facility for sewage is utilized on this site. Area water supply is derived from the limestone bedrock. The site location and operation is fair; the nearest residence is 400 metres east.

7.1.3 SITE CONDITIONS

During the site inspection on July 8, 1985, several observations were made. The site is located directly north of a section road running west from P.T.H. 8 approximately six kilometres west of the Community of Husavick. The site is approximately 100 m by 400 m in size with an active area consisting of a dumping pit approximately 30 m by

30 by 2 m deep, a bulky metallic waste pile, a 2 cell sewage pit approximately 40 m by 30 m each, an open waste pile approximately 30 m long and 2 m high and an agricultural chemical container area.

The majority of household and municipal waste is deposited at the edge of the waste pit, burned and pushed in. Currently the waste pit is full of water due to the impermeability of the sediment that the pit is located in. The site is fenced on the south side, and the nearest residence is located 400 metres to the east. The sewage holding pits are both full, with no evidence of leakage seen. The site is located immediately east of a marshy area, which is situated in a permeable gravel deposit.

7.1.4 PHYSIOGRAPHY

The site area is located on the moderately rolling basin flats of the Manitoba lowland, Interlake - Westlake plain which slopes towards Lake Winnipeg. The area around the site features a two to three metre relief with the lowest areas located to the north west. The site is situated on a depressed area with a till ridge located to the west of the site.

Surficial drainage in the area is to the west low lying area, which in turn drains into ditches running east to the lake.

Vegetation around the site consists of 60% wooded areas and 40% grassland.

7.1.5 DRILLING AND SAMPLING

A drilling and sampling program was undertaken at this site. Two test holes were drilled, three surficial water samples and one residential well sample were taken. See Appendix B for water quality analytical results and Appendix C for test hole logs.

7.2 GEOLOGIC DATA

7.2.1 GEOLOGIC SETTING

Generally, this area consists of glacial till basin plains extending from Lake Winnipeg to Lake Manitoba. The till in this area is highly calcareous and varies from gravely to clayey and permeable to impermeable respectively.

Proglacial lake levels have previously inundated this area leaving thin clay and silt deposits covering the till in places, and at some elevations sand and gravel beach ridges mark ancient lake levels. The site is located adjacent to a gravel deposit area. It appears the waste pit and sewage cells are located in impermeable clays, with more permeable deposits located immediately west of the site. (See Figure 7.3 and 7.4 in Appendix A).

7.2.2 BEDROCK

The bedrock in this area consists of Limestone and Dolostone, of the Ordovician Period. Extensive zones of fracturing and cavities allow this rock unit to store and transmit water. The bedrock surface is approximately 30 metres below grade at this site.

7.2.3 OVERBURDEN

Approximately 30 metres of overburden is found at this site, and consists of a thin silty clay layer over approximately 1 metre thick, overlying approximately 29 metres of gravelly clay till. This till overburden forms an impermeable confining layer over the bedrock.

7.2.4 GEOHYDROLOGY

The only aquifer reported in this area is the bedrock limestone aquifer, which is confined by a thick till layer. Analytical results show good quality water. Groundwater flow is easterly towards Lake Winnipeg.

7.3 ENVIRONMENTAL INTERPRETATION AND ASSESSMENT

7.3.1 LEACHATE HYDROLOGY

Leachate generated at this site by waste deposition in water filled pits, may overflow during high periods of rainfall or rapid snow melt. The results would be contaminated surface runoff into drainage ditches running east towards Lake Winnipeg.

Excess runoff or drainage from the sewage holding cells would run off into the gravel deposits located west of the site, and possibly contaminate surface water in the marsh area.

7.3.2 METHANE

Based on the amount of waste deposited at this site an estimated five million cubic metres of methane gas may be produced per year. Since the majority of the waste is burned before burial, the actual suspected quantity of methane gas generated will only be a fraction of the estimate. The migration distance of any methane gas produced should only be several metres, based on soil conditions.

7.3.3 WATER QUALITY

The water quality analysis of pond water located on a private farm 400 metres east of the site, utilized for cattle, shows good quality water with no unusual parameter levels. The water quality analysis of the deep bedrock well on this farm indicates fair to good quality water with no problem parameters.

7.3.4 CONCLUSION

Based on the surficial geology of the site area no bedrock contamination is suspected. Currently the sewage pits are full and there is the possibility of overflow, which would most likely enter into the adjacent marsh water system. Stagnant water is the waste pit was found to be high in bacteria levels. The occurrence of water in the waste pit is not considered good operating practice.

Other then the above concerns, site condition and location are good.

7.3.5 RECOMMENDATION

1. A new sewage pit should be established.
2. Water from the waste pit should be pumped into the sewage holding facility.
3. Water should not be allowed to accumulate in the waste pit and should be routinely pumped out.

APPENDIX A

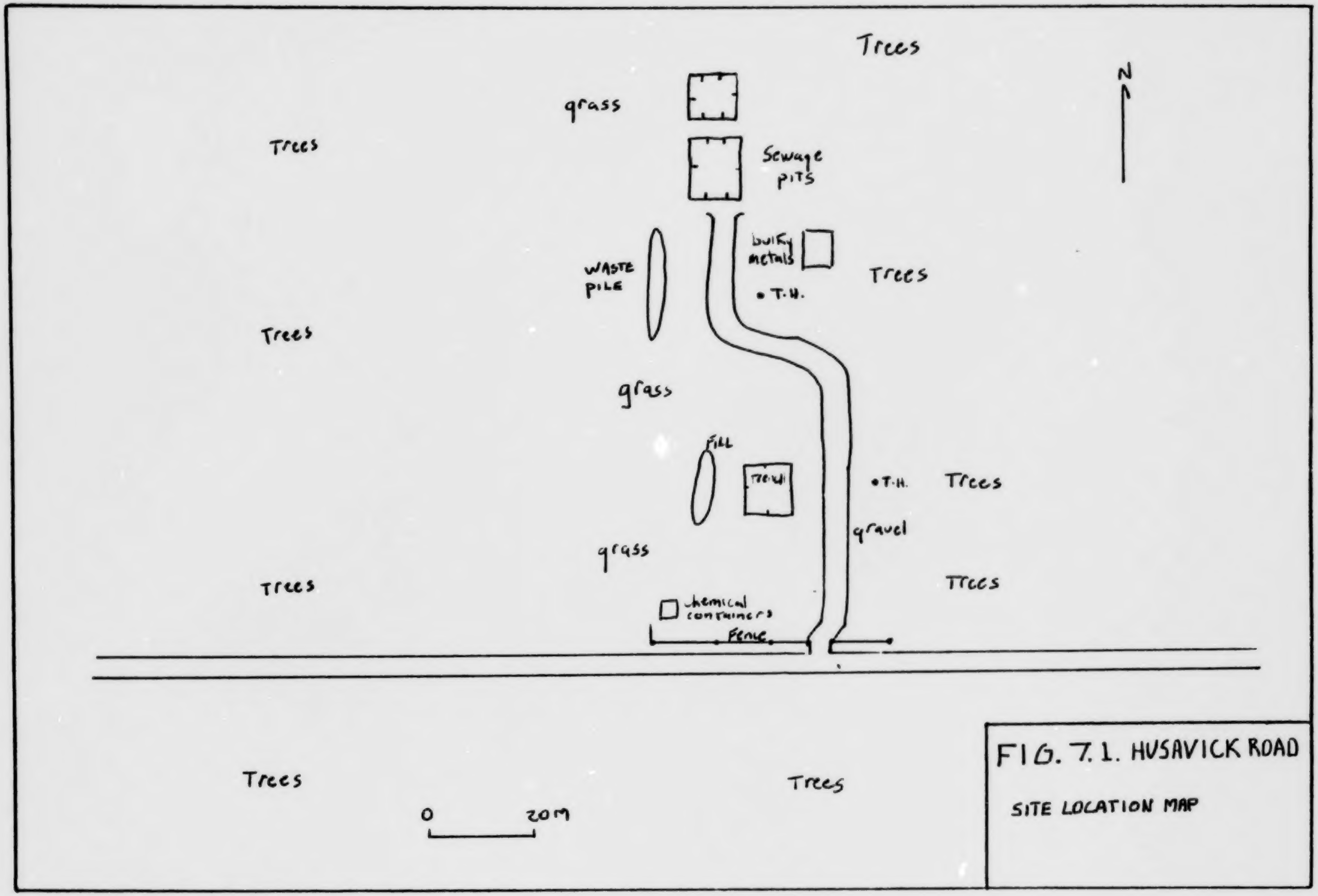

Trees
N
grass
Trees
Sewage pits
bulky metals
WASTE PILE
Trees
• T.H.
Trees
grass
FILL
TR.W
• T.H.
Trees
gravel
grass
Trees
Trees
chemical containers
Fence
Trees
Trees
0
20m

FIG. 7.1. HUSAVICK ROAD

SITE LOCATION MAP

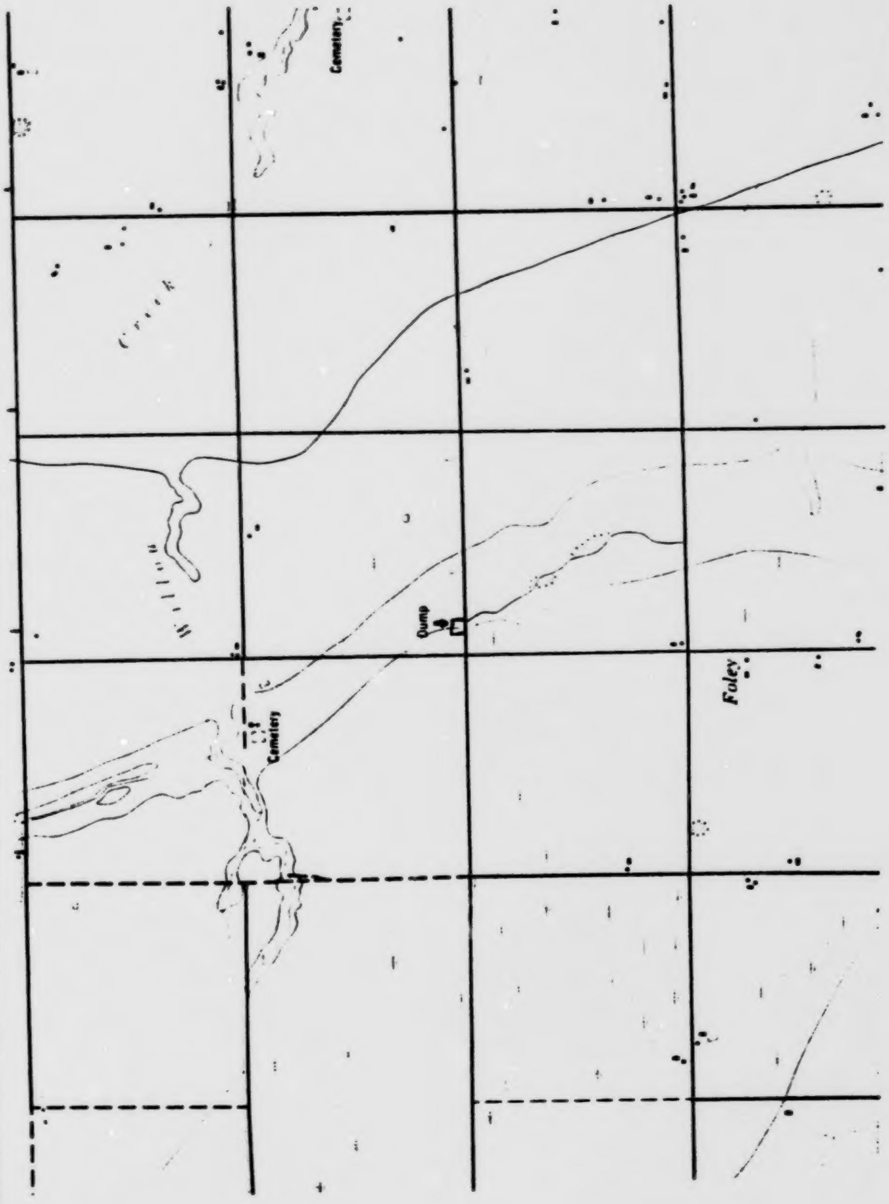

Cemetery
Creek
Willow
Dump
Cemetery
Foley

FIG. 7.2. HUSAVICK ROAD SITE LOCATION MAP

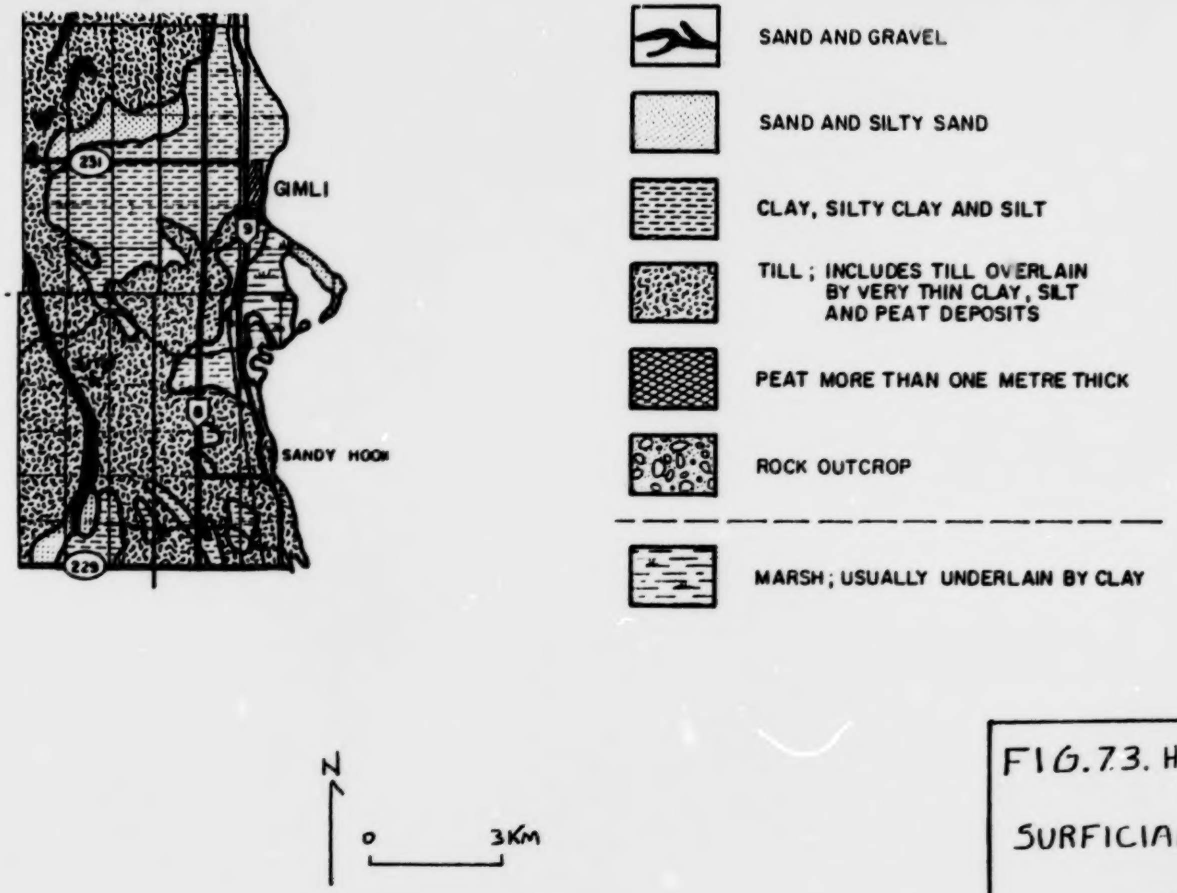

GIMLI
SANDY HOOK
231
229
SAND AND GRAVEL
SAND AND SILTY SAND
CLAY, SILTY CLAY AND SILT
TILL ; INCLUDES TILL OVERLAIN BY VERY THIN CLAY, SILT AND PEAT DEPOSITS
PEAT MORE THAN ONE METRE THICK
ROCK OUTCROP
MARSH ; USUALLY UNDERLAIN BY CLAY
N
0
3KM

FIG. 7.3. HUSAVICK ROAD SURFICIAL DEPOSITS MAP

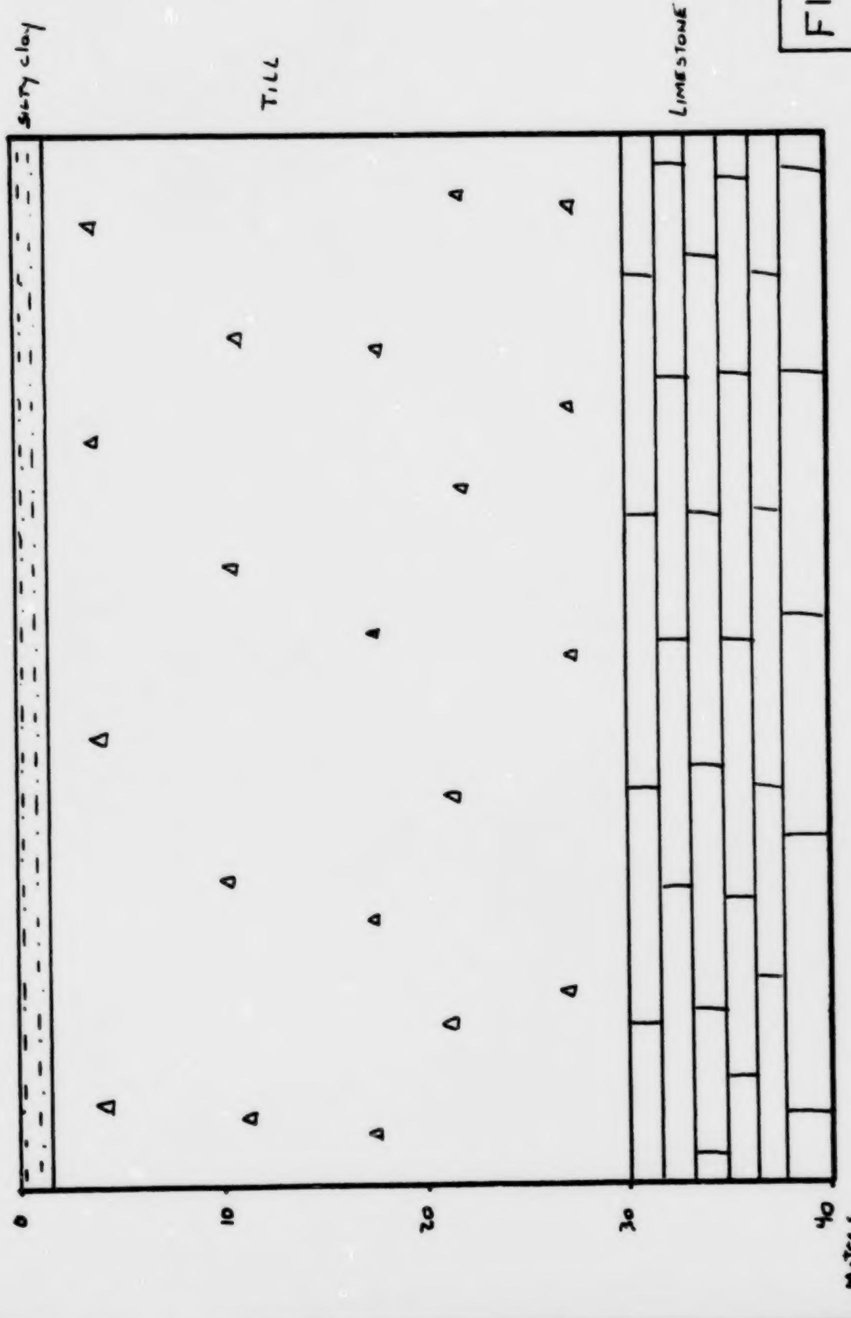

Silty clay
TILL
LIMESTONE
0
10
20
30
40
Metres

FIG. 7.4. HUSAVICK ROAD GEOLOGIC CROSS SECTION

APPENDIX B

WATER QUALITY ANALYSIS

LOCATION: Husavick Road
SAMPLE #: Residential Sample One
DATE: September 9, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	757	umho/cm
Residue Total	440	mg/l
Residue Filterable	440	mg/l
Residue Non Filterable	<5.	mg/l
pH	7.65	units
Alkalinity Total ($CaCO_3$)	336	mg/l
Alkalinity (HCO_3)	410	mg/l
Alkalinity (CO_3)	0	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	.003	mg/l
Cadmium (Ext)	.001	mg/l
Copper (Ext)	<.01	mg/l
Lead (Ext)	<.005	mg/l
Nickel (Ext)	<.005	mg/l
Zinc (Ext)	1.45	mg/l
Chromium (Ext)	<.005	mg/l
Calcium (Ext)	43.0	mg/l
Magnesium (Ext)	54.0	mg/l
Hardness ($CaCO_3$)	329.	mg/l
Manganese (Ext)	<.02	mg/l
Iron (Ext)	32	mg/l
Potassium (Ext)	<5.0	mg/l
Sodium	44.6	mg/l
COD	<10	mg/l
TOC	–	mg/l
Turbidity	1.0	NTU
CN (Total)	<.02	mg/l
Kjeldhal, Total, -N	.40	mg/l
NH_3-N. Sol.	.14	mg/l
NO_3-NO_2-N	<.01	mg/l
Phosphate Total	<.01	mg/l
Chloride	10	mg/l
Sulphate	68	mg/l
Coliform Group	0	per 100 ml
Fecal Coliform	0	per 100 ml

WATER QUALITY ANALYSIS

LOCATION: Husavick Road

SAMPLE #: Dugout Sample

DATE: September 9, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	389	umho/cm
Residue Total	240	mg/l
Residue Filterable	220	mg/l
Residue Non Filterable	16	mg/l
pH	7.85	units
Alkalinity Total ($CaCO_3$)	214	mg/l
Alkalinity (HCO_3)	261	mg/l
Alkalinity (CO_3)	0	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	.001	mg/l
Cadmium (Ext)	<.001	mg/l
Copper (Ext)	<.01	mg/l
Lead (Ext)	<.005	mg/l
Nickel (Ext)	<.005	mg/l
Zinc (Ext)	.02	mg/l
Chromium (Ext)	<.005	mg/l
Calcium (Ext)	48.4	mg/l
Magnesium (Ext)	21.5	mg/l
Hardness ($CaCO_3$)	208	mg/l
Manganese (Ext)	<.02	mg/l
Iron (Ext)	.06	mg/l
Potassium (Ext)	<5.00	mg/l
Sodium	126	mg/l
COD	41	mg/l
TOC	–	mg/l
Turbidity	4.0	NTU
CN (Total)	<.02	mg/l
Kjeldhal, Total, -N	.80	mg/l
NH_3-N. Sol.	<.02	mg/l
NO_3-NO_2-N	<.01	mg/l
Phosphate Total	.035	mg/l
Chloride	<2.0	mg/l
Sulphate	2.6	mg/l
Coliform Group	93	per 100 ml
Fecal Coliform	4	per 100 ml

WATER QUALITY ANALYSIS

LOCATION: Husavick Road
SAMPLE #: Pit One
DATE: September 9, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	2490	umho/cm
Residue Total	1510	mg/l
Residue Filterable	1500	mg/l
Residue Non Filterable	12	mg/l
pH	7.85	units
Alkalinity Total ($CaCO_3$)	570	mg/l
Alkalinity (HCO_3)	695	mg/l
Alkalinity (CO_3)	0	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	<.001	mg/l
Cadmium (Ext)	<.001	mg/l
Copper (Ext)	<.01	mg/l
Lead (Ext)	<.055	mg/l
Nickel (Ext)	<.005	mg/l
Zinc (Ext)	.09	mg/l
Chromium (Ext)	<.005	mg/l
Calcium (Ext)	54.0	mg/l
Magnesium (Ext)	90.4	mg/l
Hardness ($CaCO_3$)	505	mg/l
Manganese (Ext)	.15	mg/l
Iron (Ext)	1.10	mg/l
Potassium (Ext)	250	mg/l
Sodium	177	mg/l
COD	120	mg/l
TOC	-	mg/l
Turbidity	4.5	NTU
CN (Total)	<.02	mg/l
Kjeldhal, Total, -N	3.1	mg/l
NH_3-N. Sol.	0.14	mg/l
NO_3-NO_2-N	<.01	mg/l
Phosphate Total	.90	mg/l
Chloride	370	mg/l
Sulphate	150	mg/l
Coliform Group	9	per 100 ml
Fecal Coliform	4	per 100 ml

WATER QUALITY ANALYSIS

LOCATION: Husavick Road
SAMPLE #: Pit Two
DATE: September 9, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	2510	umho/cm
Residue Total	1480	mg/l
Residue Filterable	1470	mg/l
Residue Non Filterable	8	mg/l
pH	7.80	units
Alkalinity Total ($CaCO_3$)	580	mg/l
Alkalinity (HCO_3)	708	mg/l
Alkalinity (CO_3)	0	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	<.001	mg/l
Cadmium (Ext)	<.001	mg/l
Copper (Ext)	<.01	mg/l
Lead (Ext)	<.005	mg/l
Nickel (Ext)	<.005	mg/l
Zinc (Ext)	.13	mg/l
Chromium (Ext)	<.005	mg/l
Calcium (Ext)	54.8	mg/l
Magnesium (Ext)	92.6	mg/l
Hardness ($CaCO_3$)	520	mg/l
Manganese (Ext)	.19	mg/l
Iron (Ext)	1.55	mg/l
Potassium (Ext)	240	mg/l
Sodium	180	mg/l
COD	80	mg/l
TOC	–	mg/l
Turbidity	5.0	NTU
CN (Total)	<.02	mg/l
Kjeldhal, Total, -N	3.2	mg/l
NH_3-N. Sol.	.34	mg/l
NO_3-NO_2-N	<.01	mg/l
Phosphate Total	.55	mg/l
Chloride	390	mg/l
Sulphate	148	mg/l
Coliform Group	11000	per 100 ml
Fecal Coliform	2400	per 100 ml

APPENDIX C

GEOLOGIC LOG

LOCATION: Husavick Road Waste Disposal Site

TEST HOLE IDENTIFICATION: T.H. 1

DATE: July 12, 1985

TOTAL DEPTH: 4.2 Metres

WATER TABLE: N/A

TYPE OF CASING: N/A

TYPE OF SCREEN: N/A

DEPTH (METRES)	DESCRIPTION
0 - 1.0	sandy clay till
1.0 - 2.4	clay
2.4 - 4.2	silty clay.

GEOLOGIC LOG

LOCATION: Husavick Road Waste Disposal Site

TEST HOLE IDENTIFICATION: T.H. 2

DATE: July 12, 1985

TOTAL DEPTH: 3 Metres

WATER TABLE: N/A

TYPE OF CASING: N/A

TYPE OF SCREEN: N/A

DEPTH (METRES)	DESCRIPTION
0 - 2.0	silty clay till
2.0 - 3.0	clay till.

CHAPTER - EIGHT -

GLADSTONE

R.M. OF WESTBOURNE

SE 29-14-11W

8 GLADSTONE WASTE DISPOSAL SITE

8.1 RECONNAISSANCE DATA

8.1.1 LOCATION

The Town of Gladstone is located approximately 60 kilometres northwest of Portage la Prairie along P.T.H. 16. The waste disposal site is located approximately 1 kilometre east of town on Section SE 29-14-11W (see Figures 8.1 and 8.2 in Appendix A).

8.1.2 BACKGROUND

This site has been operating in its current location for over 20 years. In 1977 the site was registered with the Province as an existing waste disposal ground. Current records show that this site serves approximately 1000 people. Primarily municipal waste from the Town of Gladstone and household waste from surrounding rural areas is deposited at this site. An above ground dumping terrace and pit is used to dispose of common waste, while separate areas exist for bulky metallic wastes and agricultural chemical containers.

The Town's water supply is derived from the Whitemud River and treated before distribution. The town is also served by a 3 cell sewage lagoon located west of the waste disposal site.

8.1.3 SITE CONDITIONS

During the site inspection on July 22, 1985, several observations were made. The site is located immediately off a section road running approximately 1 kilometre north from P.T.H. 16. The site is approximately 160 metres by 110 metres in size with an active area consisting of a waste mound 2.5 metres high, 60 metres in diameter, with a pit area in the centre of this mound, approximately 20 metres in diameter and 2 metres deep, where garbage is burned and fill covered. Located on the south east corner of the mound is the agricultural chemical container compound. Bulky metallic waste is deposited at grade level west of the waste mound.

To the immediate north of the site runs a drainage ditch which drains the area between the sewage lagoon and the site. Site drainage is also into this ditch.

The nearest residences to the site are located in the town one kilometre away. The site location and condition is good, however this site is approaching its maximum capacity.

8.1.4 PHYSIOGRAPHY

The area is located at the edge of the Lake Agassiz basin in the Manitoba Lowlands. The topography shows next to no relief other then drainage channels. The Whitemud River, incised 3 - 5 metres into its alluvial channel bed, meanders through the area towards Lake Manitoba.

The terrain is mainly open prairie with trees supported only along channels and around farms. A shallow drainage ditch passes immediately north of the site.

8.1.5 DRILLING AND SAMPLING

A drilling and sampling program was undertaken for this site. Three monitoring wells were installed and water samples taken and submitted for analysis. Along with groundwater samples, two surficial samples from adjacent ditches were also taken. Analytical Results can be found in Appendix B, while Well Logs can be found in Appendix C.

8.2 GEOLOGIC DATA

8.2.1 GEOLOGIC SETTING

The site area is located on Lake Agassiz basin clays. These clays overlie previously deposited glacial clay till which in turn overlies bedrock. The Whitemud River, which is incised below the surrounding grade has reworked sediments in its meander loops to form alluvium and expose the glacial till locally.

Sand and gravel lenses do not exist in the basin clays and only as small pockets in the clay till. As a result, sediments are very low in overall permeability. Rainfall is absorbed by the topsoil and transpires with excess running into local drainage ditches. (See Figure 8.3 and 8.4 in Appendix A).

8.2.2 BEDROCK

At a depth of approximately 60 metres shale of the Jurassic Period is found.

8.2.3 OVERBURDEN

Two units of overburden approximately 60 metres thick overlie bedrock in this area. Approximately 57 metres of highly calcareous till with variable permeabilities overlies bedrock in this area. This unit is in turn overlain by approximately 2 metres of alluvial clay and silt.

8.2.4 GEOHYDROLOGY

Three aquifers can be found in the site area. The shale bedrock aquifer is reported unpotable in this area due to the high salt content. A shallow semiconfined aquifer can be found at a depth of approximately 1 to 3 metres below grade in the site area, and consists of clayey silt grading to silt, with moderate to poor permeability, and confined gravel and sand lenses in the till form the third type of aquifer. Groundwater flow is east.

8.3 ENVIRONMENTAL INTERPRETATION AND ASSESSMENT

8.3.1 LEACHATE HYDROLOGY

Leachate on this site is generated by precipitation infiltrating the buried waste. Due to the low permeability of the underlying sediments, leachate is not likely to enter the subsurface beyond a few metres depth. Since no wells exist in the site area and no wells are reported to be utilizing the near surface semiconfined aquifer, drinking water in the area will not be affected by any site activity.

8.3.2 METHANE

Based on the amount of waste deposited at this site an estimated 5 million cubic metres of methane gas may be generated per year. Since the waste is burned before fill covering, the actual suspected quantity of methane gas generated will only be a fraction of the estimate. The migration distance of methane gas produced should be limited to several metres.

8.3.3 WATER QUALITY

Chemical analysis of the nearby drainage ditch shows some evidence of runoff contamination. Chemical analysis of the three monitoring wells shows severe contamination, characterized by high conductivity, chloride, nitrate and sulphate levels. These results are typical indicators of sewage contamination.

8.3.4 CONCLUSION

This site poses a low environmental impact to the area. Surface runoff contamination is of low concern due to the limited nature of the runoff. The agricultural chemical container compound is located too close to the active pit area. This is conducive to containers falling into the pit or catching fire. The contamination of the silt layer is of low concern as it is not utilized by the public in the area. The source of the contamination may be the nearby sewage lagoon operations; however, a detailed study would be needed to determine its exact source. The waste disposal site operation may be contributing to the overall contamination of the silt layer somewhat.

8.3.5 RECOMMENDATIONS

1. The agricultural chemical container area should be moved further away from the active disposal area.
2. Steps to relocate or expand the site should be initiated by the town.

APPENDIX A

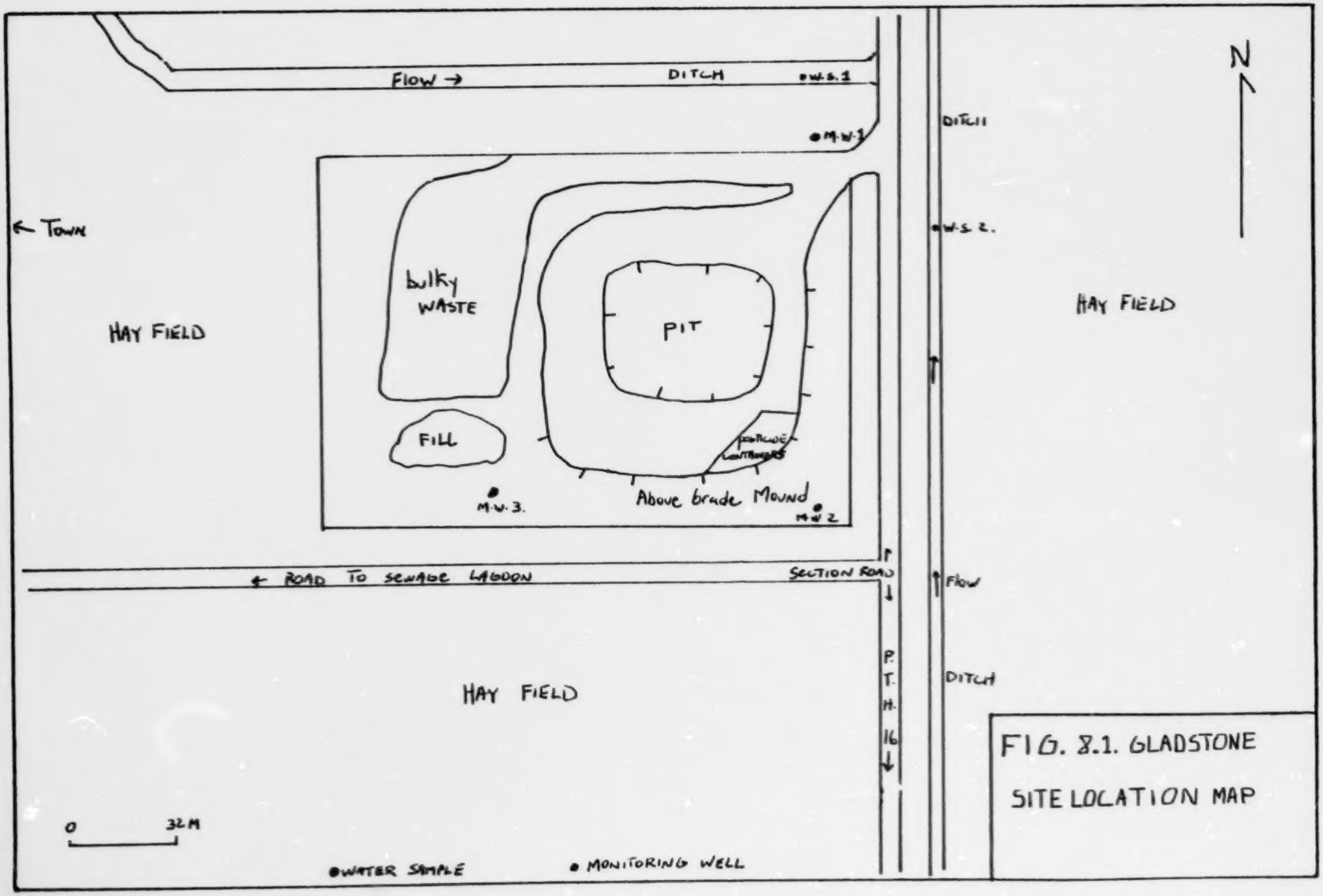

N
← Town
Flow →
DITCH
• W.S.1
• M.W.1
DITCH
• W.S. 2.
HAY FIELD
HAY FIELD
bulky WASTE
PIT
FILL
PESTICIDE CONTAINERS
M.W. 3.
Above Grade Mound
M.W 2
← ROAD TO SEWAGE LAGOON
SECTION ROAD
Flow
P. T. H. 16
DITCH
HAY FIELD
0
32 M
• WATER SAMPLE
• MONITORING WELL

FIG. 8.1. GLADSTONE SITE LOCATION MAP

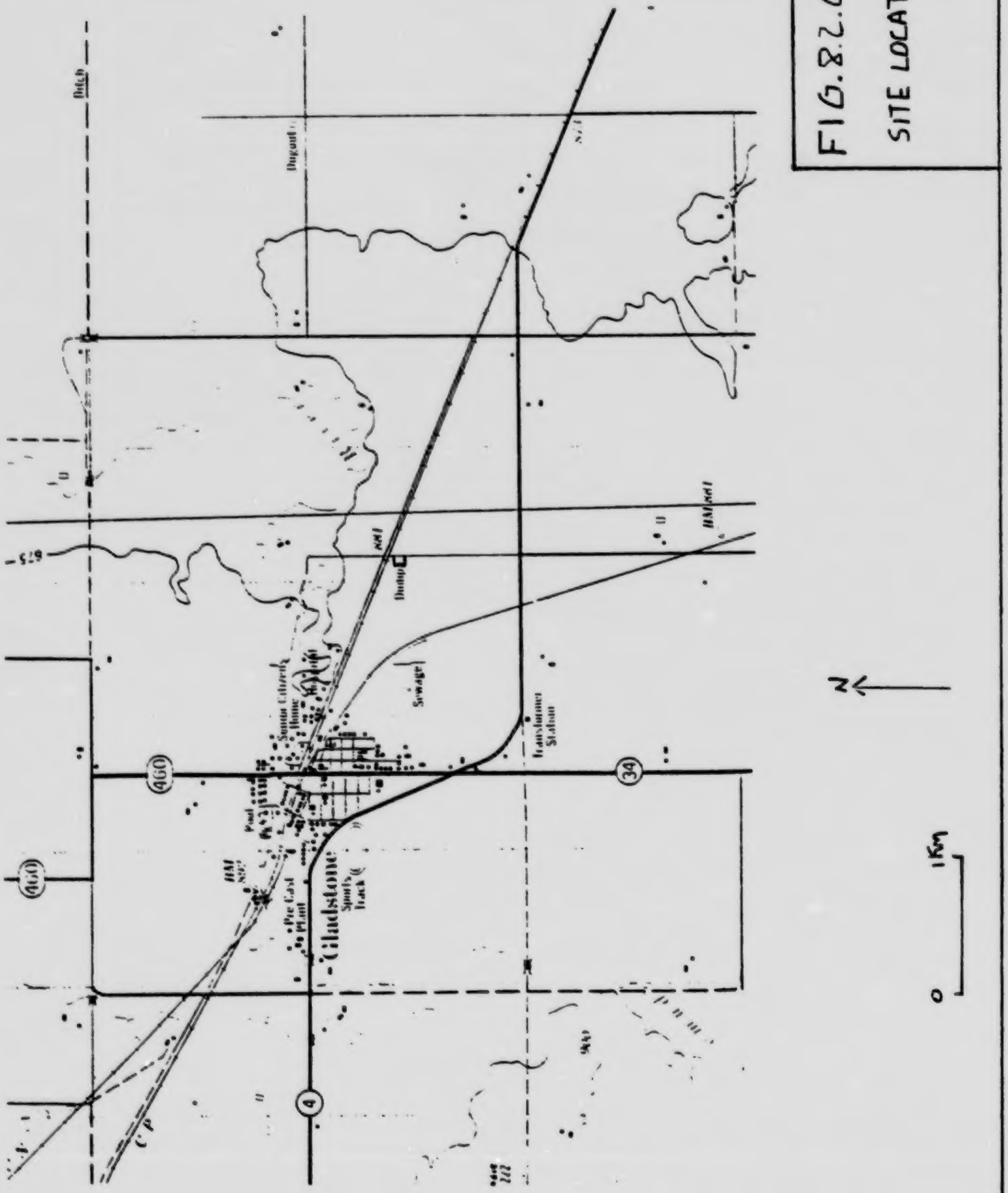

Ditch
Dugouts
Dump
Sewage
Senior Citizens Home
Pool
Pre Cast Plant
Sports Track
Gladstone
Transformer Station
460
460
34
4
CP
N
0
1Km

FIG. 8.2. GLADSTONE SITE LOCATION MAP

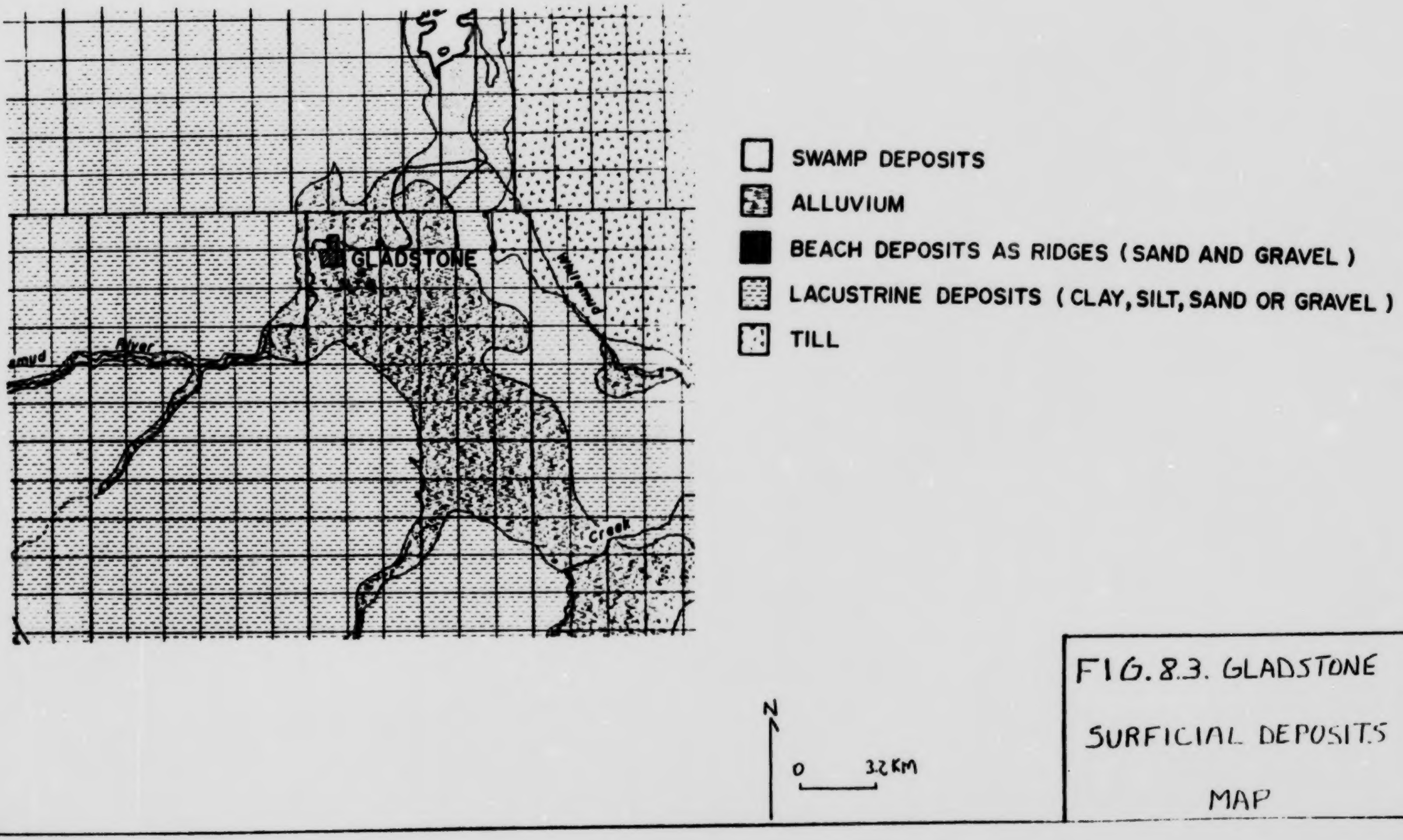

GLADSTONE
Whitemud
River
Creek
SWAMP DEPOSITS
ALLUVIUM
BEACH DEPOSITS AS RIDGES (SAND AND GRAVEL)
LACUSTRINE DEPOSITS (CLAY, SILT, SAND OR GRAVEL)
TILL
N
0
3.2 KM

FIG. 8.3. GLADSTONE SURFICIAL DEPOSITS MAP

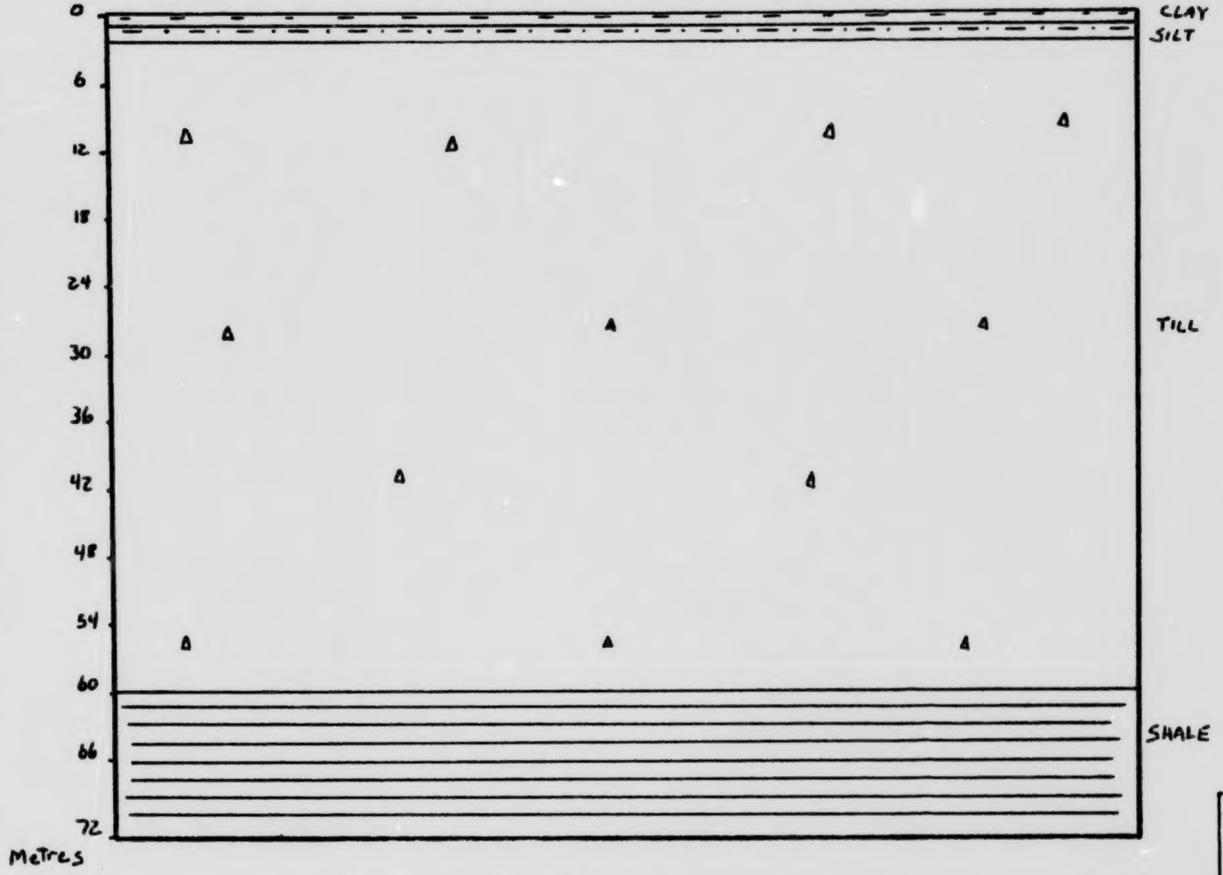

0
6
12
18
24
30
36
42
48
54
60
66
72
Metres
CLAY
SILT
TILL
SHALE

FIG. 8.4. GLADSTONE GEOLOGIC CROSS SECTION

APPENDIX B

WATER QUALITY ANALYSIS

LOCATION: Gladstone
SAMPLE #: Monitoring Well One
DATE: October 30, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	7950	umho/cm
Residue Total	8550	mg/l
Residue Filterable	8140	mg/l
Residue Non Filterable	410	mg/l
pH	7.20	units
Alkalinity Total ($CaCO_3$)	748	mg/l
Alkalinity (HCO_3)	913	mg/l
Alkalinity (CO_3)	0	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	.008	mg/l
Cadmium (Ext)	<.001	mg/l
Copper (Ext)	.02	mg/l
Lead (Ext)	<.005	mg/l
Nickel (Ext)	.017	mg/l
Zinc (Ext)	.05	mg/l
Chromium (Ext)	.015	mg/l
Calcium (Ext)	600	mg/l
Magnesium (Ext)	925	mg/l
Hardness ($CaCO_3$)	5300	mg/l
Manganese (Ext)	.22	mg/l
Iron (Ext)	3.23	mg/l
Potassium (Ext)	24.0	mg/l
Sodium	690	mg/l
COD	58	mg/l
TOC	-	mg/l
Turbidity	250	NTU
CN (Total)	-	mg/l
Kjeldhal, Total, -N	2.5	mg/l
NH_3-N. Sol.	.03	mg/l
NO_3-NO_2-N	22	mg/l
Phosphate Total	.25	mg/l
Chloride	680	mg/l
Sulphate	4080	mg/l
Coliform Group	0	per 100 ml
Fecal Coliform	0	per 100 ml

WATER QUALITY ANALYSIS

LOCATION: Gladstone

SAMPLE #: Monitoring Well Two

DATE: October 30, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	9520	umho/cm
Residue Total	9580	mg/l
Residue Filterable	9550	mg/l
Residue Non Filterable	34	mg/l
pH	7.15	units
Alkalinity Total ($CaCO_3$)	580	mg/l
Alkalinity (HCO_3)	708	mg/l
Alkalinity (CO_3)	0	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	.001	mg/l
Cadmium (Ext)	<.001	mg/l
Copper (Ext)	.05	mg/l
Lead (Ext)	<.005	mg/l
Nickel (Ext)	.026	mg/l
Zinc (Ext)	.09	mg/l
Chromium (Ext)	.005	mg/l
Calcium (Ext)	450	mg/l
Magnesium (Ext)	1000	mg/l
Hardness ($CaCO_3$)	5241	mg/l
Manganese (Ext)	.16	mg/l
Iron (Ext)	.069	mg/l
Potassium (Ext)	11.0	mg/l
Sodium	620	mg/l
COD	120	mg/l
TOC	-	mg/l
Turbidity	5.0	NTU
CN (Total)	-	mg/l
Kjeldhal, Total, -N	2.5	mg/l
NH_3-N. Sol.	.02	mg/l
NO_3-NO_2-N	165.	mg/l
Phosphate Total	.085	mg/l
Chloride	750	mg/l
Sulphate	4650	mg/l
Coliform Group	43	per 100 ml
Fecal Coliform	0	per 100 ml

WATER QUALITY ANALYSIS

LOCATION: Gladstone
SAMPLE #: Monitoring Well Three
DATE: October 30, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	12000.	umho/cm
Residue Total	13900	mg/l
Residue Filterable	13700	mg/l
Residue Non Filterable	240	mg/l
pH	7.60	units
Alkalinity Total ($CaCO_3$)	946	mg/l
Alkalinity (HCO_3)	1150	mg/l
Alkalinity (CO_3)	0	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	.006	mg/l
Cadmium (Ext)	<.001	mg/l
Copper (Ext)	.04	mg/l
Lead (Ext)	<.005	mg/l
Nickel (Ext)	.022	mg/l
Zinc (Ext)	.07	mg/l
Chromium (Ext)	.012	mg/l
Calcium (Ext)	450	mg/l
Magnesium (Ext)	1400	mg/l
Hardness ($CaCO_3$)	6887	mg/l
Manganese (Ext)	.28	mg/l
Iron (Ext)	2.98	mg/l
Potassium (Ext)	7.00	mg/l
Sodium	1110.	mg/l
COD	200	mg/l
TOC	-	mg/l
Turbidity	100	NTU
CN (Total)	-	mg/l
Kjeldhal, Total, -N	4.4	mg/l
NH_3-N. Sol.	.02	mg/l
NO_3-NO_2-N	81.	mg/l
Phosphate Total	.20	mg/l
Chloride	900	mg/l
Sulphate	7500	mg/l
Coliform Group	9	per 100 ml
Fecal Coliform	0	per 100 ml

WATER QUALITY ANALYSIS

LOCATION: Gladstone

SAMPLE #: Surface Sample One

DATE: September 11, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	2900	umho/cm
Residue Total	2460	mg/l
Residue Filterable	2440	mg/l
Residue Non Filterable	16	mg/l
pH	7.85	units
Alkalinity Total ($CaCO_3$)	224.	mg/l
Alkalinity (HCO_3)	273.	mg/l
Alkalinity (CO_3)	0	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	.006	mg/l
Cadmium (Ext)	<.001	mg/l
Copper (Ext)	<.01	mg/l
Lead (Ext)	<.005	mg/l
Nickel (Ext)	<.005	mg/l
Zinc (Ext)	<.01	mg/l
Chromium (Ext)	<.005	mg/l
Calcium (Ext)	197.	mg/l
Magnesium (Ext)	177.	mg/l
Hardness ($CaCO_3$)	1221.	mg/l
Manganese (Ext)	.15	mg/l
Iron (Ext)	.38	mg/l
Potassium (Ext)	22.0	mg/l
Sodium	185	mg/l
COD	39	mg/l
TOC	–	mg/l
Turbidity	2.5	NTU
CN (Total)	<.02	mg/l
Kjeldhal, Total, -N	2.3	mg/l
NH_3-N. Sol.	.11	mg/l
NO_3-NO_2-N	<.01	mg/l
Phosphate Total	.18	mg/l
Chloride	180	mg/l
Sulphate	1360	mg/l
Coliform Group	11	per 100 ml
Fecal Coliform	0	per 100 ml

WATER QUALITY ANALYSIS

LOCATION: Gladstone
SAMPLE #: Surface Sample Two
DATE: September 11, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	2790.	umho/cm
Residue Total	2130.	mg/l
Residue Filterable	2100.	mg/l
Residue Non Filterable	26.	mg/l
pH	7.80	units
Alkalinity Total ($CaCO_3$)	570	mg/l
Alkalinity (HCO_3)	695	mg/l
Alkalinity (CO_3)	0	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	.003	mg/l
Cadmium (Ext)	<.001	mg/l
Copper (Ext)	<.01	mg/l
Lead (Ext)	<.005	mg/l
Nickel (Ext)	.005	mg/l
Zinc (Ext)	.01	mg/l
Chromium (Ext)	<.005	mg/l
Calcium (Ext)	156	mg/l
Magnesium (Ext)	165	mg/l
Hardness ($CaCO_3$)	1069	mg/l
Manganese (Ext)	.09	mg/l
Iron (Ext)	.13	mg/l
Potassium (Ext)	10.0	mg/l
Sodium	247	mg/l
COD	87	mg/l
TOC	–	mg/l
Turbidity	6.5	NTU
CN (Total)	<.02	mg/l
Kjeldhal, Total, -N	1.0	mg/l
NH_3-N. Sol.	.08	mg/l
NO_3-NO_2-N	.05	mg/l
Phosphate Total	.075	mg/l
Chloride	<2.0	mg/l
Sulphate	11.4	mg/l
Coliform Group	39	per 100 ml
Fecal Coliform	23	per 100 ml

APPENDIX C

GEOLOGIC LOG

LOCATION: Gladstone Waste Disposal Site

TEST HOLE IDENTIFICATION: M.W. 1

DATE: Oct. 24, 1985

TOTAL DEPTH: 4.54 Metres

WATER TABLE: 1.51 Metres

TYPE OF CASING: PVC 1.5 Inch Sch. 40

TYPE OF SCREEN: Polypropylene Weave

SLOTTING LENGTH: 1.5 - 4.5 metres

FILL MATERIAL: Silica sand, 30-40 grade

DEPTH (METRES)	DESCRIPTION
0 - 1.51	silty clay, grey
1.51 - 1.96	silty sand, wet
1.96 - 3.03	silty clay, brown
3.03 - 4.54	silty clay till, firm, brown, dry.

GEOLOGIC LOG

LOCATION: Gladstone Waste Disposal Site

TEST HOLE IDENTIFICATION: M.W. 2

DATE: Oct. 24, 1985

TOTAL DEPTH: 4.54 Metres

WATER TABLE: .60 Metres

TYPE OF CASING: PVC 1.5 Inch Sch. 40

TYPE OF SCREEN: Polypropylene Weave

SLOTTING LENGTH: 1.5-4.5 metres

FILL MATERIAL: Silica sand, 30-40 grade

DEPTH (METRES)	DESCRIPTION
0 - 1.5	clayey silt, wet
1.5 - 3.03	silty clay, dry
3.03 - 4.54	clayey till.

GEOLOGIC LOG

LOCATION: Gladstone Waste Disposal Site

TEST HOLE IDENTIFICATION: M.W. 3

DATE: Oct. 24, 1985

TOTAL DEPTH: 3.03 Metres

WATER TABLE: 1.06 Metres

TYPE OF CASING: PVC 1.5 Inch Sch. 40

TYPE OF SCREEN: Polypropylene Weave

SLOTTING LENGTH: 1-3 metres

FILL MATERIAL: Silica sand, 30-40 grade

DEPTH (METRES)	DESCRIPTION
0 - .30	silty sand
.30 - 1.06	silty clay, grey
1.06 - 1.51	clayey silt, wet
1.51 - 3.03	clay till, dry

CHAPTER - NINE -

GRANDVIEW

R.M. OF GRANDVIEW

SE 31-25-23W

9 GRANDVIEW WASTE DISPOSAL SITE

9.1 RECONNAISSANCE DATA

9.1.1 LOCATION

The Town of Grandview is located approximately 45 kilometres west of Dauphin along P.T.H. 5. The waste disposal site is located approximately 1.8 kilometres north of town of Section SE 31-25-23W. (See Figure 9.1 and 9.2 in Appendix A).

9.1.2 BACKGROUND

This waste disposal site has been operating in its present location for over nine years. In 1977, the site was registered with the province as an existing waste disposal grounds. Current records show that this site serves approximately 1000 people. Primarily municipal waste from the Town of Grandview and household waste from surrounding rural areas is deposited at this site. A trench system is used to dispose of common waste, while separate piles exist for tires, bulky metallic waste, and chemical pesticide containers.

The Town's water supply is derived from the Valley River, and treated before distribution. The area is also served by a 2 cell sewage lagoon which discharges into the Valley River..

9.1.3 SITE CONDITIONS

During the site inspection on September 5, 1985, several observations were made. The site is located off a section road 1 kilometre east of P.R. 366 and 1.8 kilometres north of town. The site is approximately 160 metres by 160 metres. Two trenches are currently in use, 4 metres by 4 metres by 4 metres deep. A separate tire section, bulky metallic waste pile and chemical pesticide container area is in place.

The site is in very good condition, and is completely fenced with a gate. The nearest residence is located over 1 km away.

9.1.4 PHYSIOGRAPHY

The Grandview waste disposal site is located in the western upland region, on the valley plain level, on the flat prairie area which connects the Duck and Riding Mountains. Immediately to the south the Valley River meanders as a misfit stream in an ancient proglacial valley and is incised approximately 5 metres below the prairie level. The banks of this river are very steep and overgrown with trees. To the immediate north runs Silver Creek which is incised 2 - 3 metres below the prairie level. The banks of this stream are also overgrown with trees.

Drainage is to the south towards the Valley River.

9.1.5 DRILLING AND SAMPLING

A drilling and sampling program was not undertaken at this site.

9.2 GEOLOGIC DATA

9.2.1 GEOLOGIC SETTING

The area is located in an ancient proglacial lake basin. Lacustrine deposits overlie previously deposited glacial till, which in turn overlies bedrock.

To the south the meandering Valley River which is incised below the surrounding grade has reworked the sediments to form alluvium.

Rainfall is absorbed in the low permeable soil in the area and transpires with excess running off to the south. Further south, soils become more permeable allowing infiltration of precipitation into the overburden (Figure 9.3 in Appendix A).

9.2.2 BEDROCK

At a depth of approximately 33 metres, interbedded shale, bentonite and limestone forming the Vermillion River Formation of the Upper Cretaceous, underlies the site.

9.2.3 OVERBURDEN

Two distinct units form 33 metres of overburden covering the bedrock. The lower unit consists of approximately 28 metres of moderately calcareous till. The upper unit consists of approximately 5 metres of lacustrine deposits consisting of primarily clay, overlain by silt, with a thin covering of sand, less then 0.5 metres thick.

9.2.4 GEOHYDROLOGY

Fresh water aquifers in this area are limited. Saturated fracture zones of the bedrock contain poor quality water which is not potable.

Limited confined aquifers in the gravelly zones of the till form the only fresh water aquifers in the area. The groundwater flow is to the southeast toward the Valley River.

9.3 ENVIRONMENTAL INTERPRETATION AND ASSESSMENT

9.3.1 LEACHATE HYDROLOGY

Because of the limited aquifers in the area groundwater contamination caused by infiltration of rainwater though the waste is not suspected. No drinking or surface waters in the area should be affected, as the soils in the area of the waste disposal site do not transmit water as they are of low permeability.

9.3.2 METHANE

Based on the amount of waste deposited at this site, an estimated 2.5 million cubic metres of methane gas per year may be generated. Since the majority of the waste is burned before burial, the actual suspected quantity of methane gas generated will only be a fraction of the estimate. The migration distance of any methane gas generated should be limited to approximately a 40 metre radius around the buried waste.

9.3.3 WATER QUALITY

Water quality of the bedrock aquifer at depth is reported to be of very poor quality, hence drinking water supply for the area is derived from the Valley River and is treated before distribution. Leachate from the site will not affect this aquifer quality, nor the quality of the Valley River water.

9.3.4 CONCLUSION

This site poses a very low environmental impact on the area and is in very good operating condition. The site is located over 1 kilometre from the nearest dwelling, therefore contamination of any limited gravel aquifer wells in the area is unlikely, also methane gas migration is not considered a problem as no buildings are located in the site area.

APPENDIX A

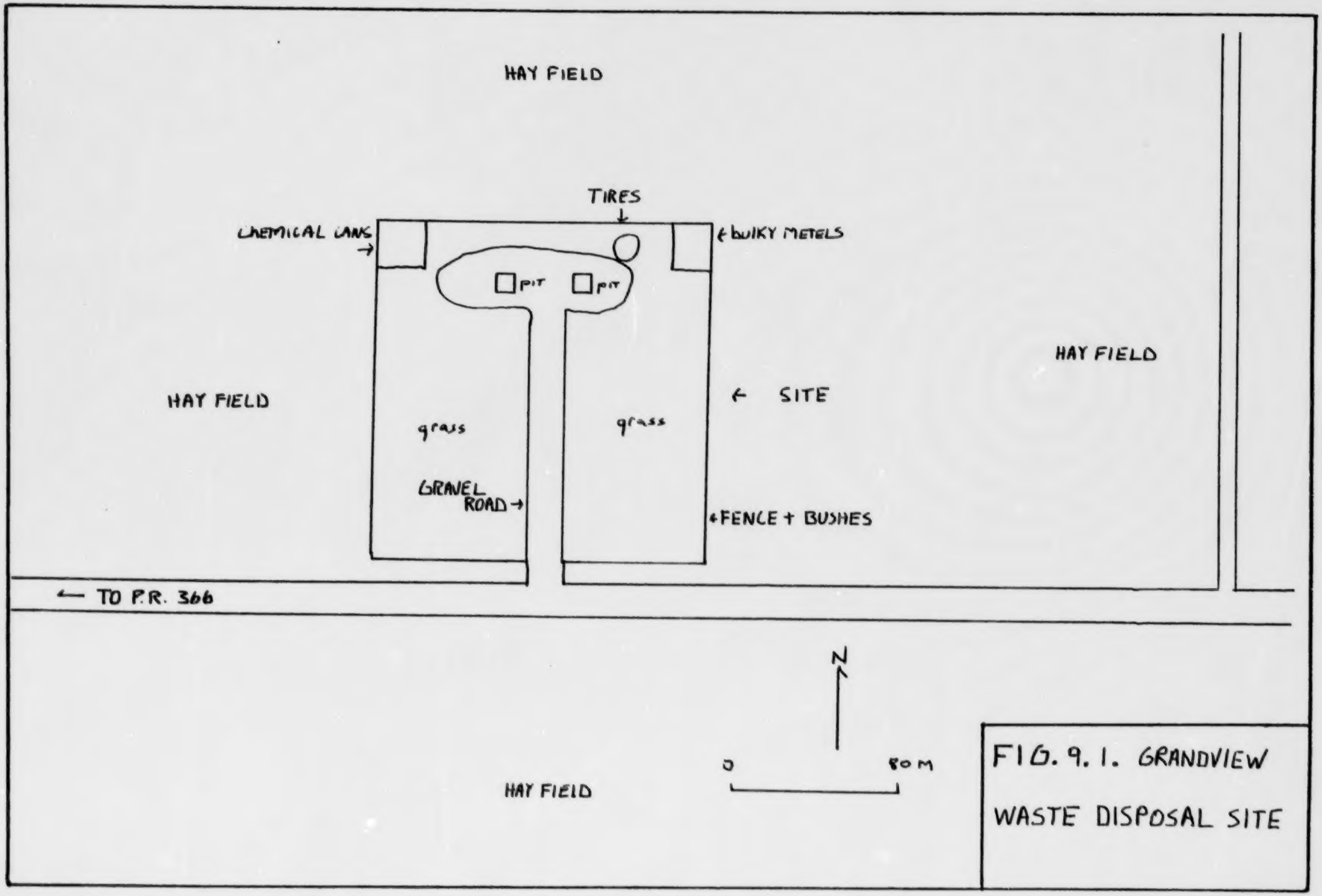

HAY FIELD
TIRES
CHEMICAL CANS
PIT
PIT
BULKY METELS
HAY FIELD
HAY FIELD
← SITE
grass
grass
GRAVEL ROAD
FENCE + BUSHES
← TO P.R. 366
N
0
80 M
HAY FIELD

FIG. 9. 1. GRANDVIEW WASTE DISPOSAL SITE

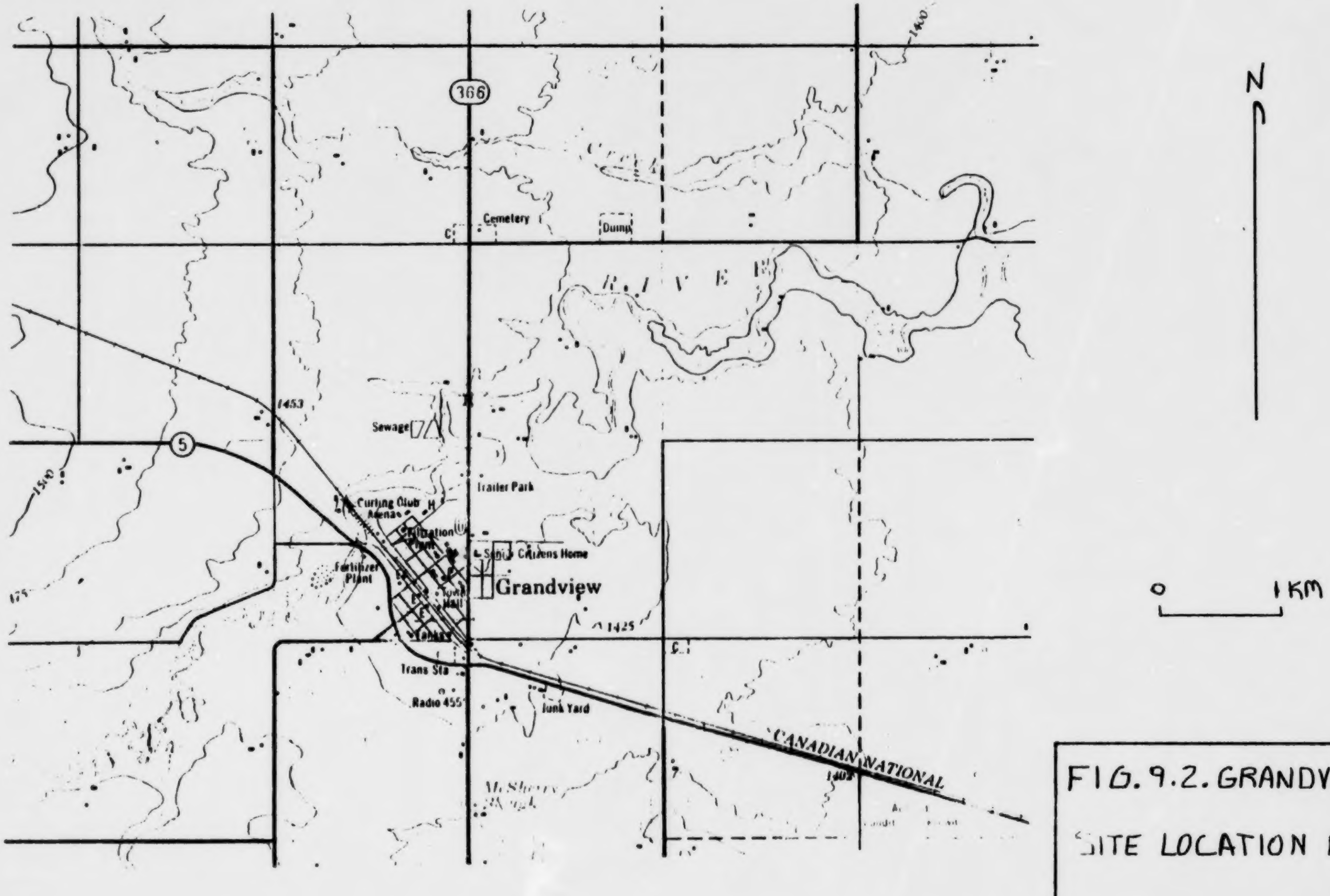

N
0
1 KM
366
5
Cemetery
C
Dump
Creek
RIVER
1400
1453
1500
Sewage
Trailer Park
Curling Club Arenas
Filtration Plant
Senior Citizens Home
Grandview
Fertilizer Plant
Town Hall
1425
Trans Sta
Radio 455
Junk Yard
CANADIAN NATIONAL
1405
McSherry

FIG. 9.2. GRANDVIEW SITE LOCATION MAP

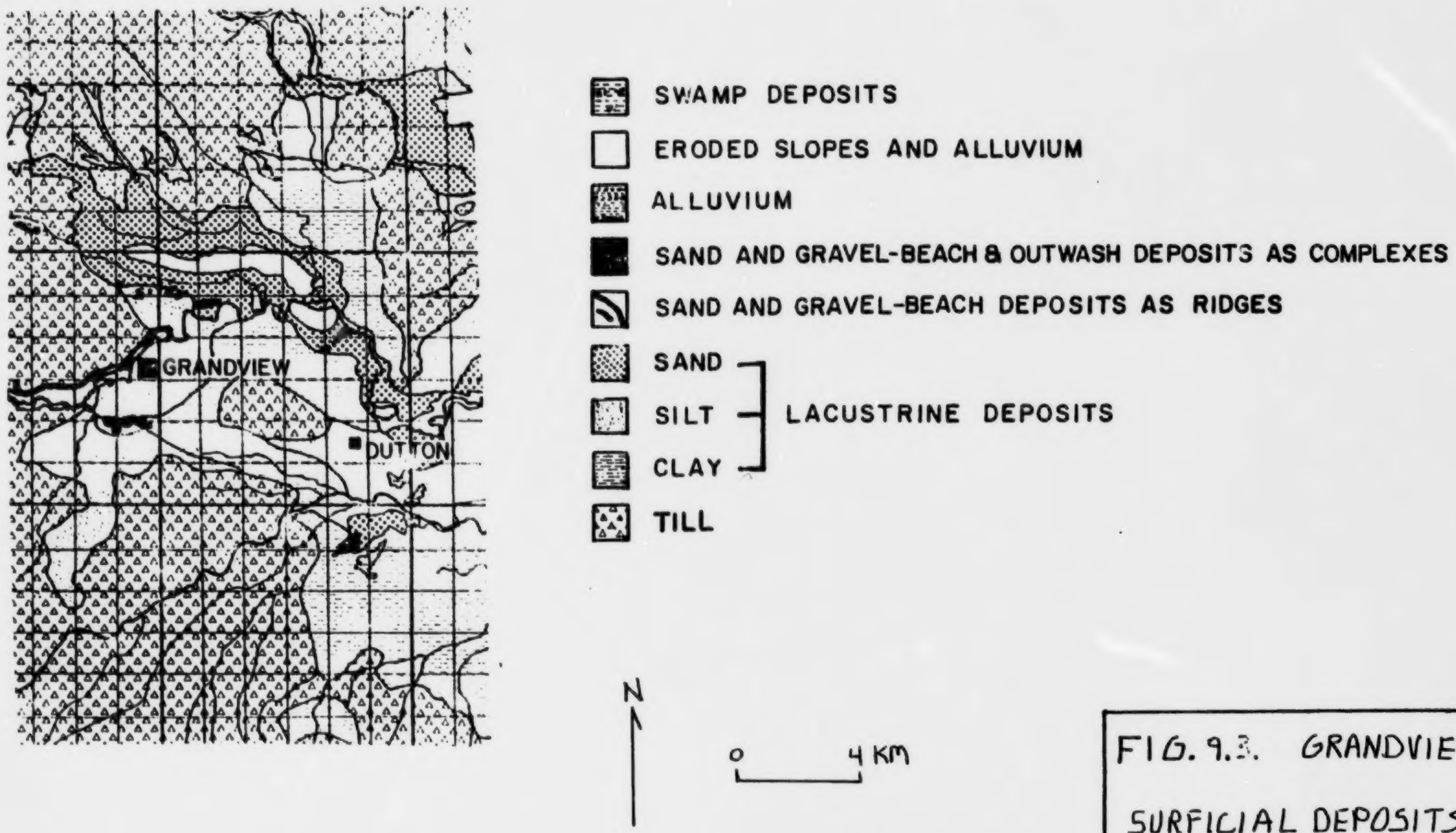

GRANDVIEW
DUTTON
SWAMP DEPOSITS
ERODED SLOPES AND ALLUVIUM
ALLUVIUM
SAND AND GRAVEL-BEACH & OUTWASH DEPOSITS AS COMPLEXES
SAND AND GRAVEL-BEACH DEPOSITS AS RIDGES
SAND
SILT
CLAY
LACUSTRINE DEPOSITS
TILL
N
0
4 KM

FIG. 9.3. GRANDVIEW SURFICIAL DEPOSITS MAP

CHAPTER - TEN-

MACGREGOR

R.M. OF NORTH NORFOLK

SW 11-12-10W

10 MACGREGOR WASTE DISPOSAL SITE

10.1 RECONNAISSANCE DATA

10.1.1 LOCATION

The Village of MacGregor is located approximately 40 kilometres west of Portage la Prairie along the Trans Canada Highway. The waste disposal site is located approximately 2 kilometres northeast of the Village on Section SW 11-12-10W. (See Figure 10.1 and 10.2 in Appendix A).

10.1.2 BACKGROUND

This waste disposal site has been operating in its present location for over twenty years. In 1977, the site was registered with the province as an existing waste disposal ground. Current records show that this site serves approximately 1600 people. Primarily household waste from surrounding rural areas and municipal waste from the Village of MacGregor is deposited at this site. A trench method of waste disposal is in use and some sewage is deposited along with the solid waste. A separate area for agricultural chemical containers and bulky wastes is in place. Village residents derive water from Squirrel Creek, which is treated before distribution. Rural residents derive water from the shallow surficial aquifer.

10.1.3 SITE CONDITIONS

During the site inspection on September 4, 1985, several observations were made. The site is located 1.6 kilometres north of the Trans Canada Highway, directly east of the north running section road. The site covers an area of approximately 80 metres by 80 metres, with the active area consisting of a L shaped trench approximately 3 metres deep and 80 metres long and 3 metres wide. Waste is deposited at the edge of the trench, burned, then pushed into the trench and covered with fill. Sewage is also dumped directly into these trenches. There is no liquid waste pit. A separate area for agricultural containers is located in the southwest corner of the site, with a bulky construction and tree waste pile located east of the container area. The site is not fenced. At the time of inspection groundwater levels were high, and as a consequence the waste trench was filled with water. The nearest residence is located over one kilometre away. The site operation is fair as several operational practices could be improved.

10.1.4 PHYSIOGRAPHY

The site area is located in the gently rolling sand flat area of the Assiniboine Delta which connects the Southwestern Uplands with the Manitoba Lowlands. The area features moderate relief.

Approximately 1 kilometre north of the site the Beaver Creek, incised approximately 2 metres below grade meanders through the area.

The site is located in a forested area, with some agricultural land use located to the south. Drainage of precipitation and snow melt is directly into the surficial aquifer via very permeable sandy soil.

10.1.5 DRILLING AND SAMPLING

A drilling and sampling program was undertaken for this site. Three groundwater monitoring wells were installed and sampled. Groundwater sample analysis can be found in Appendix B, while well logs can be found in Appendix C.

10.2 GEOLOGIC DATA

10.2.1 GEOLOGIC SETTING

The area is located on the far eastern part of the proglacial Assiniboine Delta. Surficial windblown sands overly a sequence of interbedded deltaic deposits of silt, sand and clay. The deltaic deposit forms a major unconfined aquifer in south central Manitoba. (See Figure 10.3 and 10.4 in Appendix A).

10.2.2 BEDROCK

The bedrock underlying this area consists primarily of shales from the Jurassic Period. These shales are frequently interbedded with other sedimentary rocks such as thin sandstone, limestone and gypsum layers.

The eroded bedrock surface has been logged at a depth of approximately 90 metres in this area.

10.2.3 OVERBURDEN

Two units make up approximately 90 metres of overburden overlying the bedrock. The lower unit consists of highly calcareous till with variable permeabilities and is approximately 80 metres thick. The upper unit, consisting of deltaic deposits of sand, silt and clay comprise approximately 10 metres of the upper overburden.

10.2.4 GEOHYDROLOGY

The deltaic sediment unit beneath the site forms part of a major unconfined aquifer in this region. Recharge occurs by direct infiltration of precipitation into the surficial sands. The geology suggests that the groundwater flow is towards the northeast.

10.3 ENVIRONMENTAL ASSESSMENT AND INTERPRETATION

10.3.1 LEACHATE HYDROLOGY

Two sources for leachate production exist on the site; the buried waste in the disposal trenches, and the sewage disposed of in the trenches.

Under normal conditions, the base of the disposal trench is located approximately 1 to 2 metres above the water table, but consecutive wet seasons have brought the water table in direct contact with the waste in the trenches, increasing leachate production.

Sewage disposal on the site infiltrates directly through the clean surficial sand into the aquifer and, when deposited directly into water filled trenches, migrates directly into the aquifer.

10.3.2 METHANE

Based on the amount of waste deposited at this site an estimated 6.6 million cubic metres of methane gas per year may be generated. Since the majority of waste is burned before burial, the actual suspected quantity of methane gas produced will only be a fraction of the estimate. Methane gas migration should be limited to approximately 30 to 40 metres, based on the soil conditions.

10.3.3 WATER QUALITY

Water samples were taken from the three monitoring wells. Chemical analysis of the water samples shows contamination is occurring. Levels of arsenic, chromium, manganese and iron were found to be above the Canadian drinking water maximum acceptable concentrations, in monitoring wells numbers two and three.

10.3.4 CONCLUSION

Due to the geologic conditions and disposal practices, this site contaminates the groundwater in the area. Since waste is deposited in a water filled trench, leaching of contaminants occurs on a consistent basis, also the practice of sewage disposal in the trench adds to the level of contamination. The site can be improved by the utilization of a proper pit for sewage disposal and an above ground depositional system for the garbage. The nearest residence to the site is located 500 metres south. The nearest downstream residence to the site is located 1 kilometre to the east. Contamination of residential area wells does not appear likely.

10.3.5 RECOMMENDATIONS

1. A proper sewage disposal pit be established.
2. While water tables are high, waste should be deposited in shallower trenches or in an above grade waste mound.
3. A regular sampling program of the monitoring wells be implemented.
4. Residential wells be sampled in the site area.

APPENDIX A

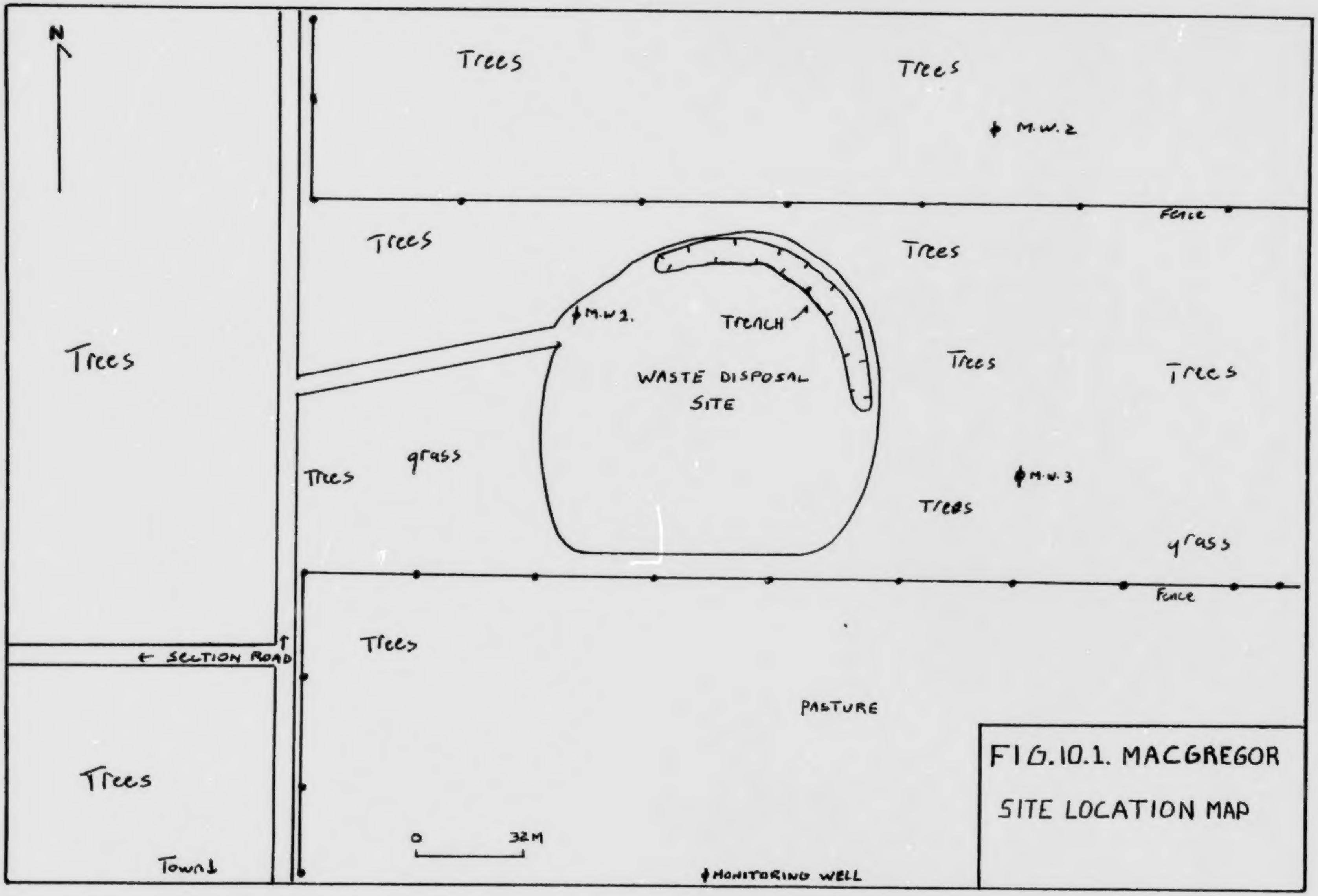

N
Trees
Trees
M.W.2
Trees
Trees
Fence
Trees
M.W.1.
Trench
WASTE DISPOSAL SITE
Trees
Trees
grass
M.W.3
Trees
grass
Fence
← SECTION ROAD
Trees
PASTURE
Trees
Town
0
32M
MONITORING WELL

FIG.10.1. MACGREGOR SITE LOCATION MAP

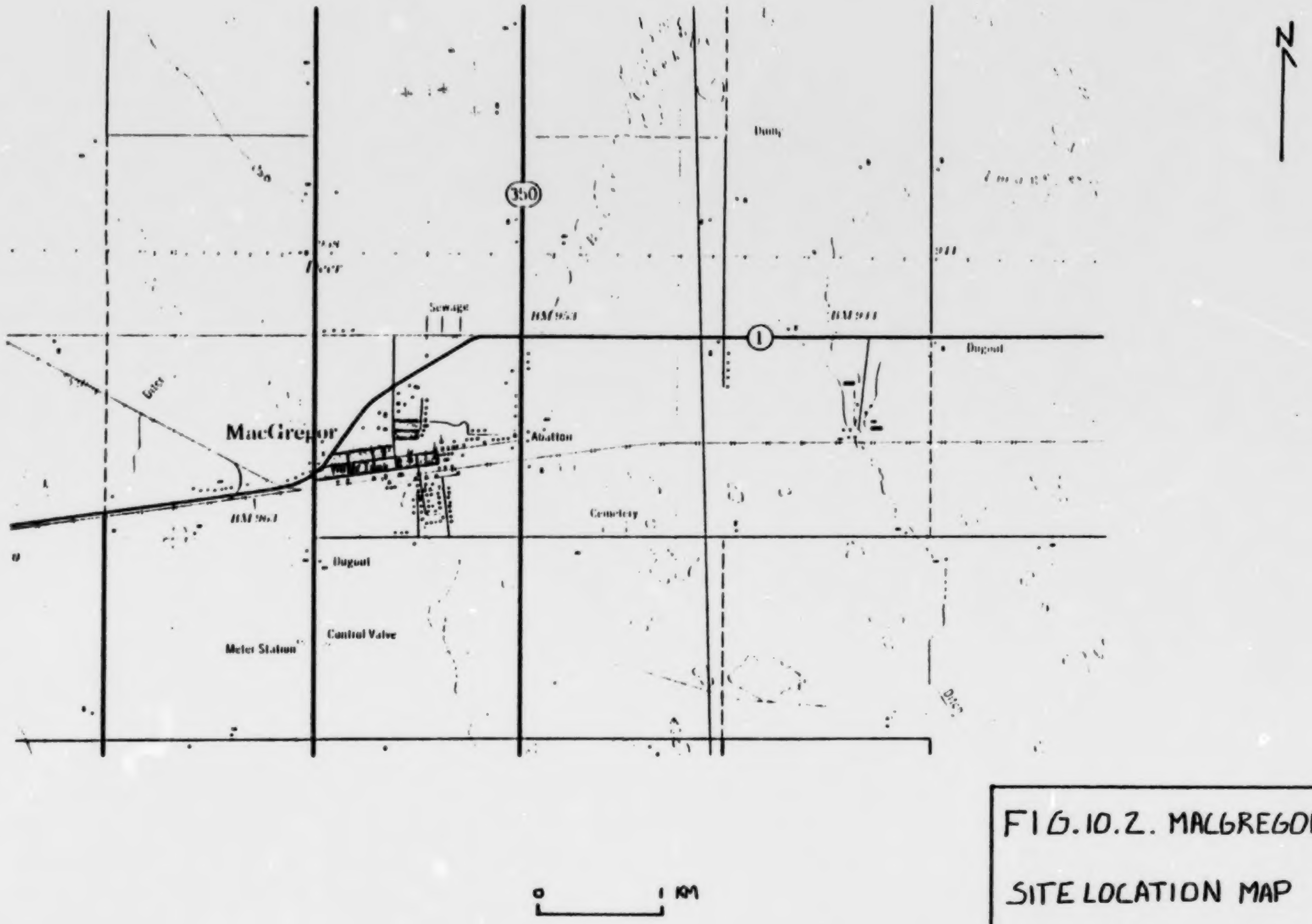

N
Dump
350
1
Sewage
BM 953
BM 941
Dugout
MacGregor
Abattoir
Cemetery
BM 963
Ditch
Dugout
Control Valve
Meter Station
0
1 KM

FIG. 10.2. MACGREGOR SITE LOCATION MAP

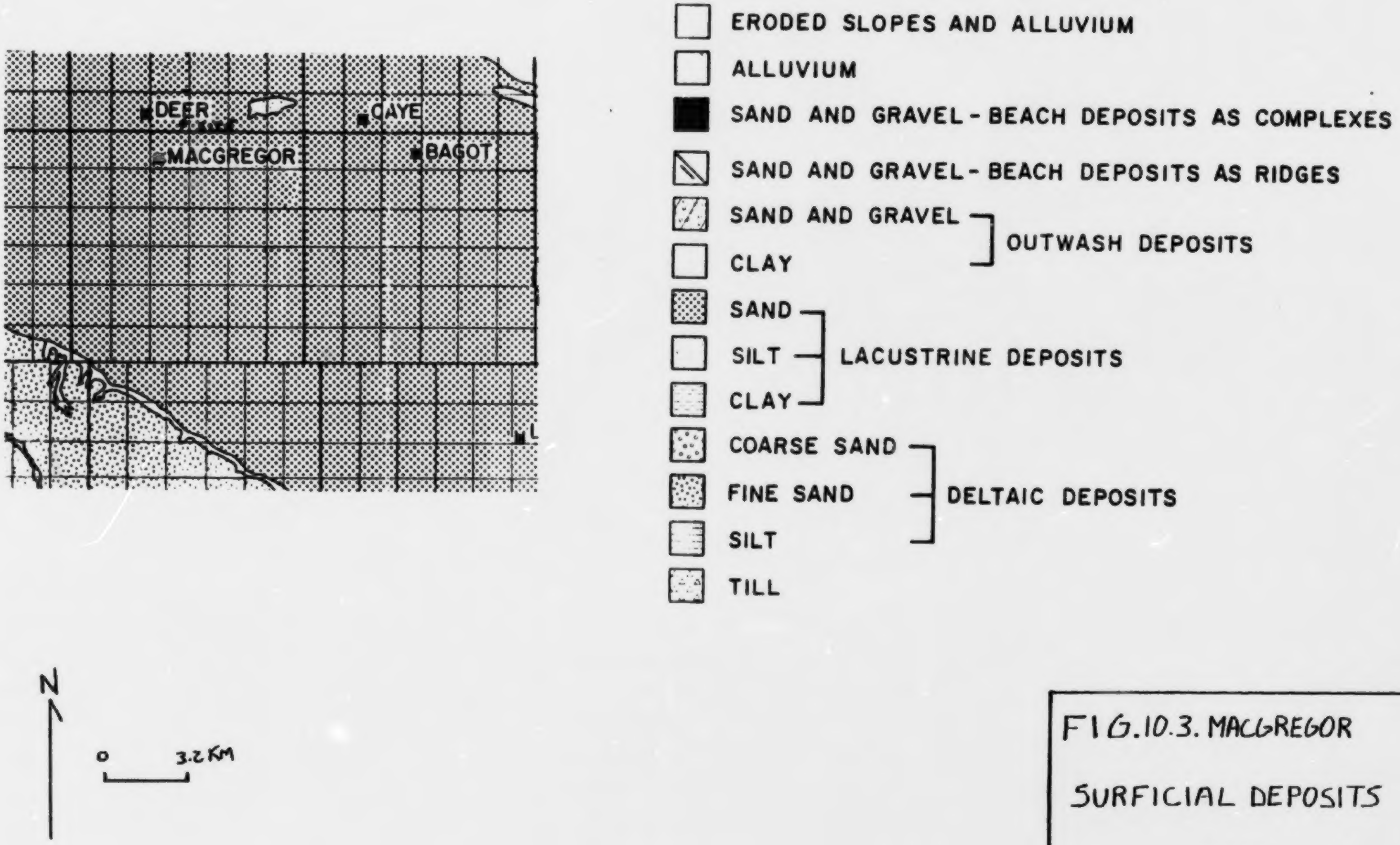

DEER
CAYE
BAGOT
MACGREGOR
L
ERODED SLOPES AND ALLUVIUM
ALLUVIUM
SAND AND GRAVEL - BEACH DEPOSITS AS COMPLEXES
SAND AND GRAVEL - BEACH DEPOSITS AS RIDGES
SAND AND GRAVEL
CLAY
OUTWASH DEPOSITS
SAND
SILT
CLAY
LACUSTRINE DEPOSITS
COARSE SAND
FINE SAND
SILT
DELTAIC DEPOSITS
TILL
N
0
3.2 KM

FIG. 10.3. MACGREGOR SURFICIAL DEPOSITS MAP

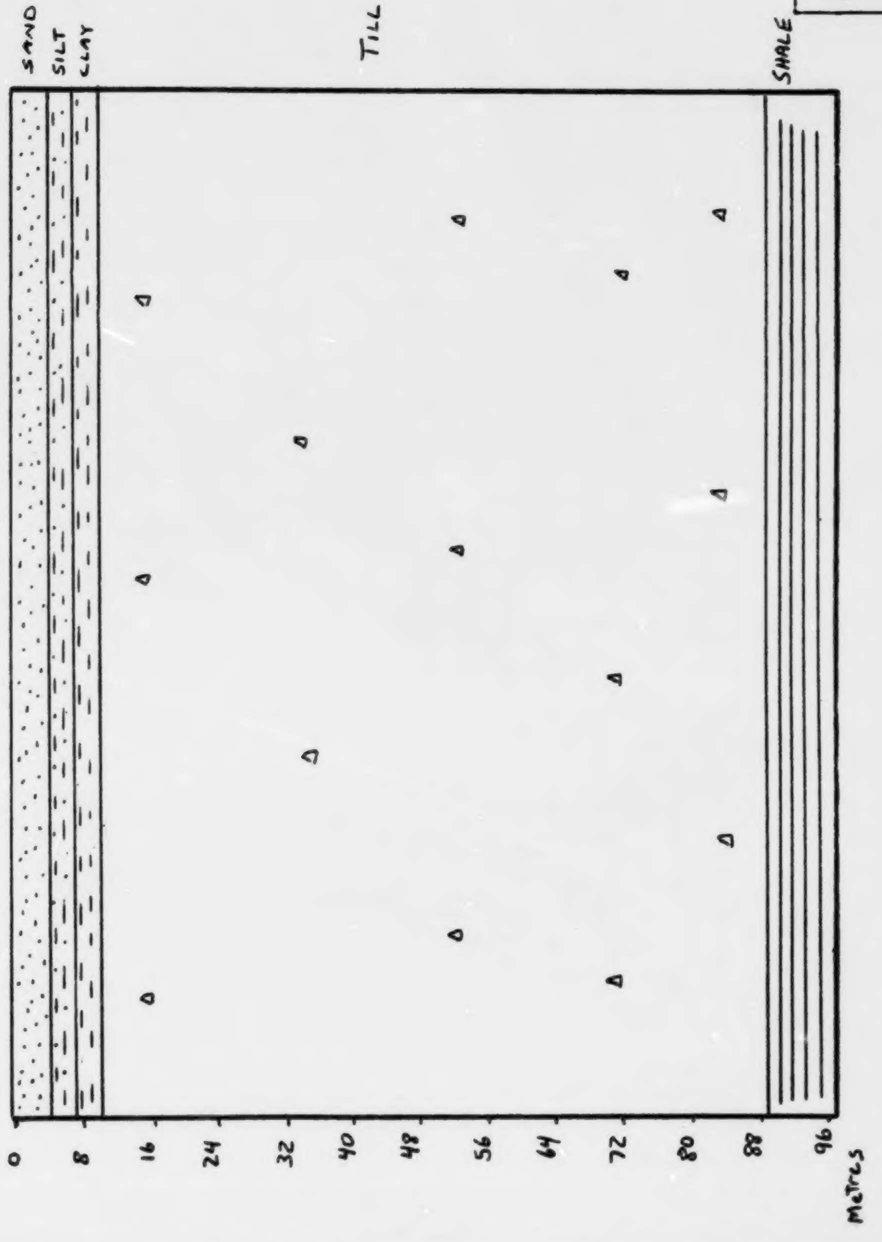

SAND
SILT
CLAY
TILL
SHALE
0
8
16
24
32
40
48
56
64
72
80
88
96
Metres

FIG. 10.4. MACGREGOR GEOLOGIC CROSS SECTION

APPENDIX B

WATER QUALITY ANALYSIS

LOCATION: MacGregor
SAMPLE #: Monitoring Well One
DATE: October 30, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	2530	umho/cm
Residue Total	2250	mg/l
Residue Filterable	2130	mg/l
Residue Non Filterable	120	mg/l
pH	6.95	units
Alkalinity Total ($CaCO_3$)	378	mg/l
Alkalinity (HCO_3)	461	mg/l
Alkalinity (CO_3)	0	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	.014	mg/l
Cadmium (Ext)	<.001	mg/l
Copper (Ext)	.01	mg/l
Lead (Ext)	.005	mg/l
Nickel (Ext)	.018	mg/l
Zinc (Ext)	.05	mg/l
Chromium (Ext)	<.005	mg/l
Calcium (Ext)	358	mg/l
Magnesium (Ext)	113	mg/l
Hardness ($CaCO_3$)	1360	mg/l
Manganese (Ext)	1.33	mg/l
Iron (Ext)	11.8	mg/l
Potassium (Ext)	7.50	mg/l
Sodium	96.3	mg/l
COD	260	mg/l
TOC	-	mg/l
Turbidity	100	NTU
CN (Total)	-	mg/l
Kjeldhal, Total, -N	2.4	mg/l
NH_3-N. Sol.	.62	mg/l
NO_3-NO_2-N	.78	mg/l
Phosphate Total	.11	mg/l
Chloride	270	mg/l
Sulphate	800	mg/l
Coliform Group	15	per 100 ml
Fecal Coliform	0	per 100 ml

WATER QUALITY ANALYSIS

LOCATION: MacGregor
SAMPLE #: Monitoring Well Two
DATE: October 30, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	512	umho/cm
Residue Total	1990	mg/l
Residue Filterable	460	mg/l
Residue Non Filterable	1530	mg/l
pH	7.45	units
Alkalinity Total ($CaCO_3$)	272	mg/l
Alkalinity (HCO_3)	332	mg/l
Alkalinity (CO_3)	0	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	.044	mg/l
Cadmium (Ext)	.003	mg/l
Copper (Ext)	.07	mg/l
Lead (Ext)	.008	mg/l
Nickel (Ext)	.013	mg/l
Zinc (Ext)	.19	mg/l
Chromium (Ext)	.05	mg/l
Calcium (Ext)	172	mg/l
Magnesium (Ext)	55	mg/l
Hardness ($CaCO_3$)	657	mg/l
Manganese (Ext)	1.96	mg/l
Iron (Ext)	37.4	mg/l
Potassium (Ext)	<5.0	mg/l
Sodium	9.76	mg/l
COD	260	mg/l
TOC	-	mg/l
Turbidity	1000	NTU
CN (Total)	-	mg/l
Kjeldhal, Total, -N	1.1	mg/l
NH_3-N. Sol.	.05	mg/l
NO_3-NO_2-N	.35	mg/l
Phosphate Total	1.4	mg/l
Chloride	8	mg/l
Sulphate	8.4	mg/l
Coliform Group	93	per 100 ml
Fecal Coliform	43	per 100 ml

WATER QUALITY ANALYSIS

LOCATION: MacGregor
SAMPLE #: Monitoring Well Three
DATE: October 30, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	565	umho/cm
Residue Total	7100	mg/l
Residue Filterable	800	mg/l
Residue Non Filterable	6240	mg/l
pH	7.35	units
Alkalinity Total ($CaCO_3$)	378	mg/l
Alkalinity (HCO_3)	461	mg/l
Alkalinity (CO_3)	0	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	.57	mg/l
Cadmium (Ext)	.002	mg/l
Copper (Ext)	.02	mg/l
Lead (Ext)	.034	mg/l
Nickel (Ext)	.045	mg/l
Zinc (Ext)	.09	mg/l
Chromium (Ext)	.17	mg/l
Calcium (Ext)	750	mg/l
Magnesium (Ext)	96.	mg/l
Hardness ($CaCO_3$)	2270	mg/l
Manganese (Ext)	4.93	mg/l
Iron (Ext)	15.4	mg/l
Potassium (Ext)	<5.0	mg/l
Sodium	7.00	mg/l
COD	270	mg/l
TOC	-	mg/l
Turbidity	-	NTU
CN (Total)	-	mg/l
Kjeldhal, Total, -N	.50	mg/l
NH_3-N. Sol.	.12	mg/l
NO_3-NO_2-N	.05	mg/l
Phosphate Total	3.9	mg/l
Chloride	7.0	mg/l
Sulphate	48	mg/l
Coliform Group	0	per 100 ml
Fecal Coliform	0	per 100 ml

APPENDIX C

GEOLOGIC LOG

LOCATION: MacGregor Waste Disposal Site

TEST HOLE IDENTIFICATION: M.W. 1

DATE: Oct. 23, 1985

TOTAL DEPTH: 6.06 Metres

WATER TABLE: .90 Metres

TYPE OF CASING: PVC 1.5 Inch Sch. 40

TYPE OF SCREEN: Polypropylene Weave

SLOTTING LENGTH: 3-6 metres

FILL MATERIAL: Silica sand, 30-40 grade

DEPTH (METRES)	DESCRIPTION
0 - .30	sandy topsoil
.30 - 2.12	fine sand, brown
2.12 - 3.93	S.A.A., grey
3.93 - 4.8	silty clay, sticky
4.8 - 6.06	silty clay, firm, dry.

GEOLOGIC LOG

LOCATION: MacGregor Waste Disposal Site

TEST HOLE IDENTIFICATION: M.W. 2

DATE: Oct. 23, 1985

TOTAL DEPTH: 6.06 Metres

WATER TABLE: 1.21 Metres

TYPE OF CASING: PVC 1.5 Inch Sch. 40

TYPE OF SCREEN: Polypropylene Weave

SLOTTING LENGTH: 3-6 metres

FILL MATERIAL: Silica sand, 30-40 grade

DEPTH (METRES)	DESCRIPTION
0 - .30	sandy topsoil
.30 - 2.12	clean fine sand, brown
2.12 - 3.63	grey silty sand
3.63 - 5.15	clayey silt
5.15 - 6.06	silty clay, dry.

GEOLOGIC LOG

LOCATION: MacGregor Waste Disposal Site

TEST HOLE IDENTIFICATION: M.W. 3

DATE: Oct. 23, 1985

TOTAL DEPTH: 5.33 Metres

WATER TABLE: 1.21 Metres

TYPE OF CASING: PVC 1.5 Inch Sch. 40

TYPE OF SCREEN: Polypropylene Weave

SLOTTING LENGHT: 2.3-5.3 metres

FILL MATERIAL: Silica sand, 30-40 grade

DEPTH (METRES)	DESCRIPTION
0 - .30	sandy topsoil
.30 - 2.15	silty brown sand
2.15 - 2.42	grey silty sand
2.42 - 5.33	firm grey clay, dry.

CHAPTER - ELEVEN -

MELITA

R.M. OF ARTHUR

SE 32-3-26W

11 MELITA WASTE DISPOSAL SITE

11.1 RECONNAISSANCE DATA

11.1.1 LOCATION

The Town of Melita is located approximately 100 kilometres southwest of Brandon along P.T.H. 83. The waste disposal site is located approximately 3.5 kilometres southeast of the Town on Section SE 32-3-26W. (See Figure 11.1 and 11.2 in Appendix A).

11.1.2 BACKGROUND

The waste disposal site has been operating on this location for approximately 20 years. In 1977 the site was registered with the province as an existing waste disposal ground. Current records indicate that this site serves approximately 2000 people. Primarily municipal waste from the Town of Melita and household waste from surrounding rural residents is deposited at this site. An open dumping and burning system and a trench is used to dispose of garbage. A separate agricultural chemical container compound and bulky metallic waste section are currently in place.

The town water supply is derived from three wells, and treated before distribution. Rural residents derive water from shallow sand and gravel lenses in the till or from the bedrock aquifer.

11.1.3 SITE CONDITIONS

During the site inspection on September 4, 1985, several observations were made. The site is located directly off an east-west running section road located 3.5 kilometres southeast of the town. The site covers an area of approximately 175 by 175 metres with an active area of approximately 150 by 80 metres. The active area consists of a bulky metallic waste section, an agricultural chemical container compound, several waste dumping and burning areas, and a small trench, approximately 3 metres deep and 15 metres in diameter.

Waste is deposited above grade in two areas, burned, and at the time of inspection was not fill covered. Waste is also deposited in a trench and burned, along with tires on occasion. The entire site is fenced, with the majority of the active area strewn with waste debris. The site location is good as the nearest residence is over 400 metres away. The site condition is fair, as there are some operational practices which may be improved.

11.1.4 PHYSIOGRAPHY

The site is located in the southwestern Manitoba Uplands, on the Souris Plain, on the prairie level which connects Turtle and Riding Mountains. The site area is characterized by the glacial spillway in which the Souris River meanders through, as a misfit river. There are gently rolling till ridges on the borders of this spillway.

Several gravel pits are located in the site area. Drainage is into back cutting channels running north to the Souris River. Land utilization is basically agricultural, with no trees in the area.

11.1.5 DRILLING AND SAMPLING

A drilling and sampling program was undertaken at this site. Three groundwater monitoring wells were installed around the site area, and water samples taken and submitted for analysis. Analytical results of the water samples are found in Appendix B, while geologic logs of the wells are found in Appendix C.

11.2 GEOLOGIC DATA

11.2.1 GEOLOGIC SETTING

The site area is situated on the border of a glacial spillway in which the Souris River meanders. The Souris River has reworked and deposited sediments to form alluvial deposits, which overlies glacial spillway alluvium. Regionally, the area is located in the proglacial Souris Lake basin, consisting of clay overlying till. (See Figure 11.3 and 11.4 in Appendix A).

11.2.2 BEDROCK

The bedrock at this location is shale of the cretaceous age at approximately 15 metres depth.

11.2.3 OVERBURDEN

Two major units form approximately 15 metres of overburden in the site area. The upper unit, consisting of approximately 3 metres of lacustrine sand, silt and clay overlies the lower unit of moderately calcareous till, approximately 12 metres thick.

11.2.4 GEOHYDROLOGY

Two types of aquifers are found in the site area. The lower aquifer is the fractured shale bedrock, confined by the till layer and the upper aquifer is the unconfined surficial sand unit. Recharge of the latter aquifer occurs by direct infiltration of precipitation. Groundwater flow is towards the northeast. The thickness of the sand aquifer varies greatly throughout the site areas, with the thinnest sections dry during times of drought. Water quality of this aquifer is variable upon location.

11.3 ENVIRONMENTAL INTERPRETATION AND ASSESSMENT

11.3.1 LEACHATE HYDROLOGY

Since the sand unit beneath the site forms an unconfined aquifer, this area is pollution sensitive. Leachates will be generated during times of snow melt and precipitation and will migrate freely to the groundwater. The bedrock aquifer at depth is not likely to be affected because of the low permeability till which separates it from the surficial sand aquifer.

11.3.2 METHANE

Based on the amount of waste deposited at this site an estimated 10 million cubic metres of methane gas per year may be generated. Since the majority of waste is burned before burial, the actual suspected quantity of methane gas produced will only be a fraction of the estimate. Migration distance of any gas generated should be limited to a distance of approximately 40 metres, based on the soil conditions.

11.3.3 WATER QUALITY

Chemical analysis of the water samples indicated that, overall, the quality of the water can be considered as fair. There was no evidence of contamination in any of the monitoring wells.

11.3.4 CONCLUSION

Based on the available data to date this site poses a low environmental impact to the site area. However site operation and upkeep can be improved. There appears to be inadequate fill cover being utilized as seen by the uncovered waste littered throughout the site area. As well there are many dumping and burning areas located on the site and no real central disposal area. Also the burning of rubber tires is unacceptable.

11.3.5 RECOMMENDATIONS

1. One centralized dumping and burial location be established.
2. A sign should be posted indicating no burning of tires.
3. A monitoring well sampling program should be established.
4. Strewn burned and unburned waste should be collected and buried.

APPENDIX A

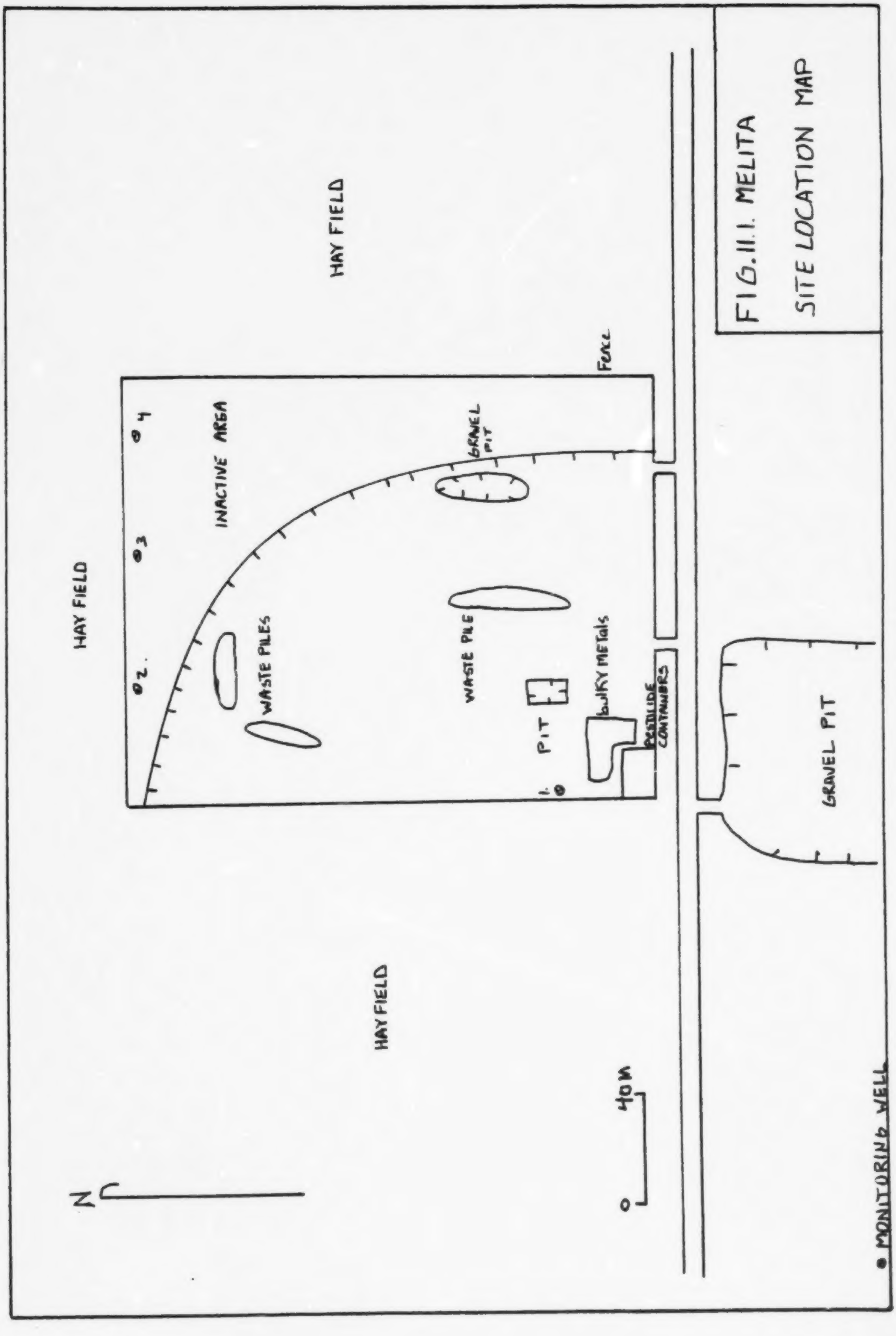

HAY FIELD
HAY FIELD
HAYFIELD
Fence
INACTIVE AREA
GRAVEL PIT
WASTE PILES
WASTE PILE
BULKY METALS
PIT
PESTICIDE CONTAINERS
GRAVEL PIT
1
2
3
4
N
0
40m
● MONITORING WELL

FIG.III.1. MELITA SITE LOCATION MAP

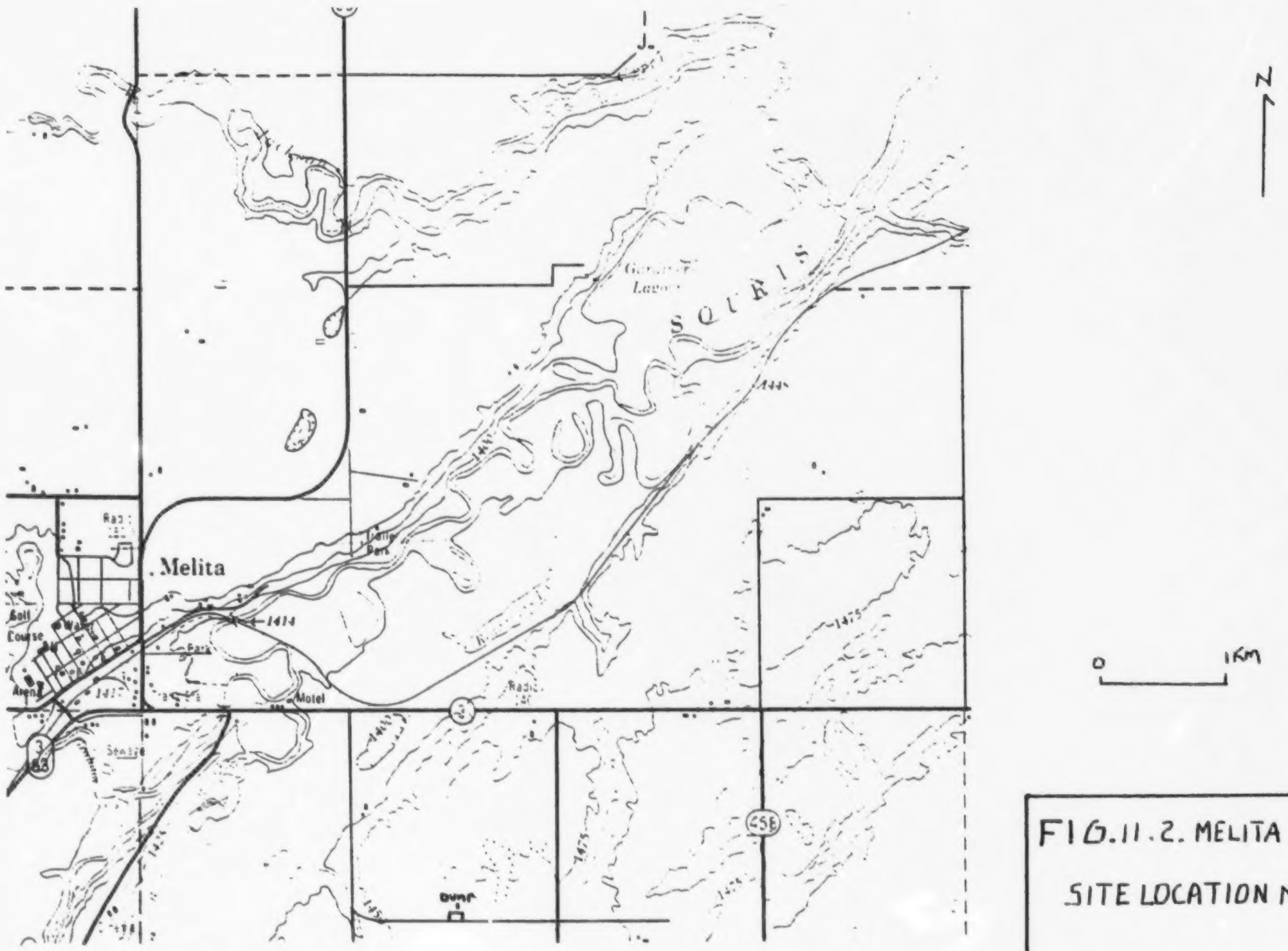

N
0
1KM
Melita
SOURIS
1414
1444
1475
Golf Course
Arena
Park
Motel
Dump
3
83

FIG.11.2. MELITA
SITE LOCATION MAP

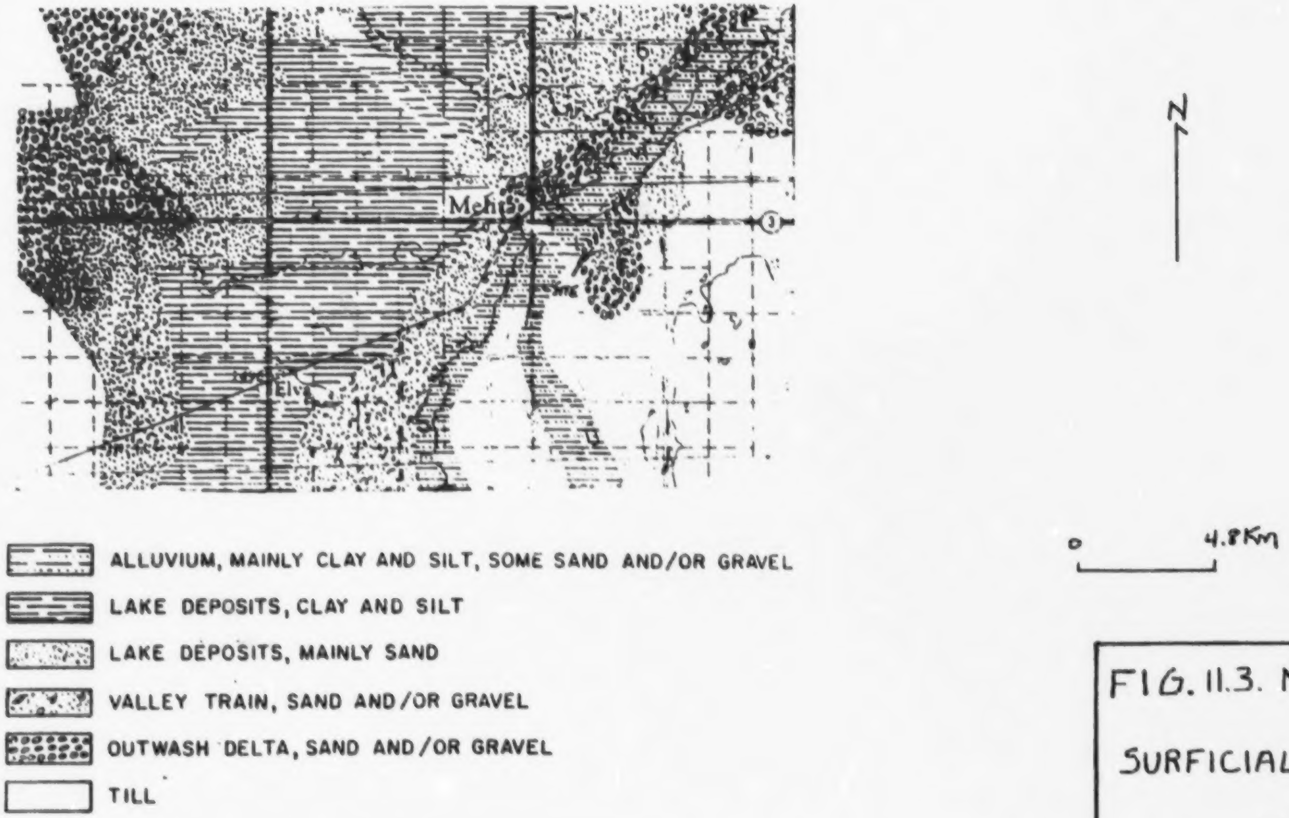

Melita
3
N
0
4.8Km
ALLUVIUM, MAINLY CLAY AND SILT, SOME SAND AND/OR GRAVEL
LAKE DEPOSITS, CLAY AND SILT
LAKE DEPOSITS, MAINLY SAND
VALLEY TRAIN, SAND AND/OR GRAVEL
OUTWASH DELTA, SAND AND/OR GRAVEL
TILL

FIG. 11.3. MELITA

SURFICIAL DEPOSITS

MAP

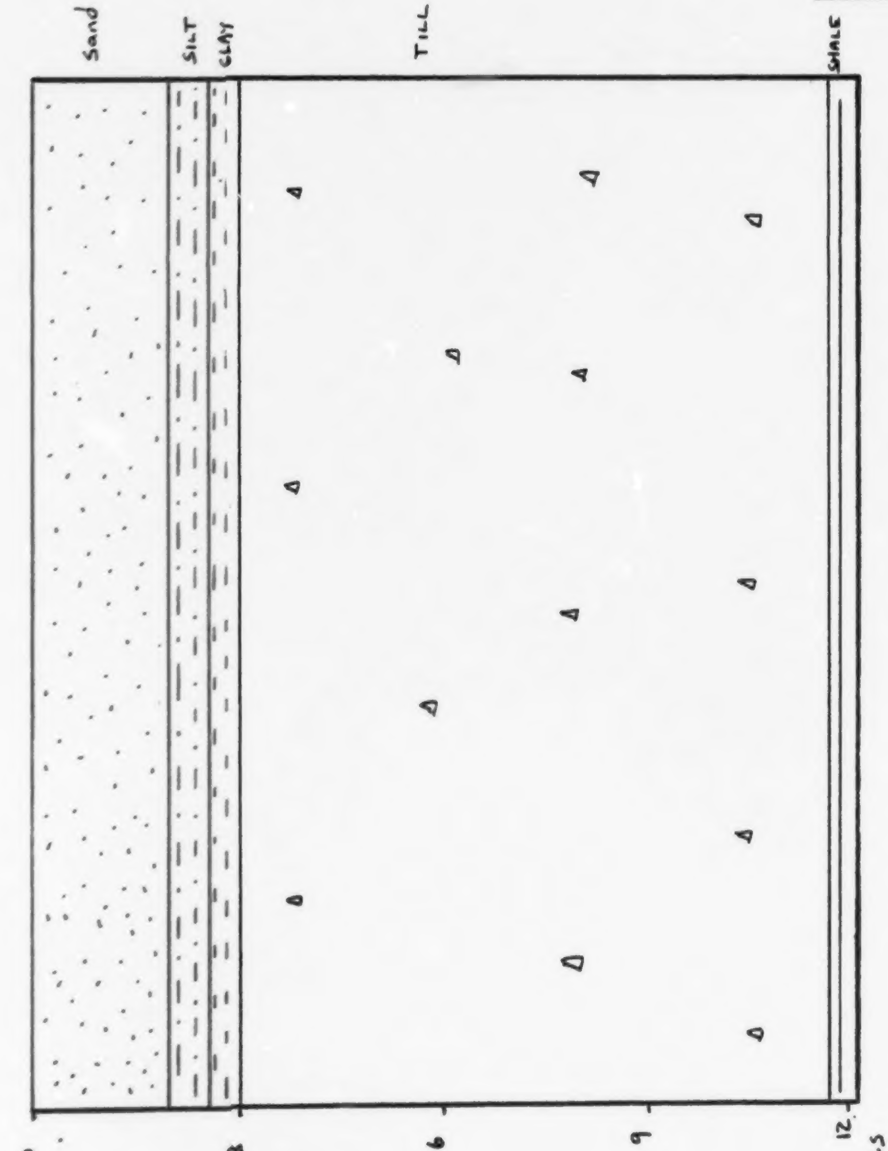

Sand
SILT
CLAY
TILL
SHALE
0
3
6
9
12
Metres

FIG. II. 4. MELITA GEOLOGIC CROSS SECTION

APPENDIX B

WATER QUALITY ANALYSIS

LOCATION: Melita
SAMPLE #: Monitoring Well One
DATE: November 2, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	2160	umho/cm
Residue Total	2050	mg/l
Residue Filterable	1670	mg/l
Residue Non Filterable	380	mg/l
pH	7.40	units
Alkalinity Total ($CaCO_3$)	518	mg/l
Alkalinity (HCO_3)	632	mg/l
Alkalinity (CO_3)	0	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	.009	mg/l
Cadmium (Ext)	<.001	mg/l
Copper (Ext)	<.01	mg/l
Lead (Ext)	<.005	mg/l
Nickel (Ext)	.034	mg/l
Zinc (Ext)	.04	mg/l
Chromium (Ext)	.015	mg/l
Calcium (Ext)	224	mg/l
Magnesium (Ext)	120	mg/l
Hardness ($CaCO_3$)	1050	mg/l
Manganese (Ext)	1.15	mg/l
Iron (Ext)	7.06	mg/l
Potassium (Ext)	36.0	mg/l
Sodium	114	mg/l
COD	44	mg/l
TOC	-	mg/l
Turbidity	200	NTU
CN (Total)	-	mg/l
Kjeldhal, Total, -N	1.6	mg/l
NH_3-N. Sol.	.22	mg/l
NO_3-NO_2-N	9.80	mg/l
Phosphate Total	.28	mg/l
Chloride	160	mg/l
Sulphate	516	mg/l
Coliform Group	4	per 100 ml
Fecal Coliform	0	per 100 ml

WATER QUALITY ANALYSIS

LOCATION: Melita
SAMPLE #: Monitoring Well Two
DATE: November 2, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	669	umho/cm
Residue Total	1440	mg/l
Residue Filterable	430	mg/l
Residue Non Filterable	1010	mg/l
pH	7.90	units
Alkalinity Total ($CaCO_3$)	256	mg/l
Alkalinity (HCO_3)	312	mg/l
Alkalinity (CO_3)	0	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	.002	mg/l
Cadmium (Ext)	.001	mg/l
Copper (Ext)	.02	mg/l
Lead (Ext)	.013	mg/l
Nickel (Ext)	.037	mg/l
Zinc (Ext)	.14	mg/l
Chromium (Ext)	.035	mg/l
Calcium (Ext)	125	mg/l
Magnesium (Ext)	56.1	mg/l
Hardness ($CaCO_3$)	543	mg/l
Manganese (Ext)	1.59	mg/l
Iron (Ext)	12.8	mg/l
Potassium (Ext)	5.50	mg/l
Sodium	40.7	mg/l
COD	49	mg/l
TOC	-	mg/l
Turbidity	750	NTU
CN (Total)	-	mg/l
Kjeldhal, Total, -N	.70	mg/l
NH_3-N. Sol.	.03	mg/l
NO_3-NO_2-N	8.40	mg/l
Phosphate Total	.29	mg/l
Chloride	28	mg/l
Sulphate	50	mg/l
Coliform Group	93	per 100 ml
Fecal Coliform	0	per 100 ml

WATER QUALITY ANALYSIS

LOCATION: Melita
SAMPLE #: Monitoring Well Three
DATE: November 2, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	653	umho/cm
Residue Total	7030	mg/l
Residue Filterable	390	mg/l
Residue Non Filterable	6640	mg/l
pH	8.00	units
Alkalinity Total ($CaCO_3$)	588	mg/l
Alkalinity (HCO_3)	717	mg/l
Alkalinity (CO_3)	0	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	.160	mg/l
Cadmium (Ext)	.002	mg/l
Copper (Ext)	.04	mg/l
Lead (Ext)	.009	mg/l
Nickel (Ext)	.28	mg/l
Zinc (Ext)	.14	mg/l
Chromium (Ext)	.24	mg/l
Calcium (Ext)	440	mg/l
Magnesium (Ext)	113	mg/l
Hardness ($CaCO_3$)	1565	mg/l
Manganese (Ext)	7.24	mg/l
Iron (Ext)	15.2	mg/l
Potassium (Ext)	7.50	mg/l
Sodium	74.1	mg/l
COD	250	mg/l
TOC	-	mg/l
Turbidity	-	NTU
CN (Total)	-	mg/l
Kjeldhal, Total, -N	.70	mg/l
NH_3-N. Sol.	.21	mg/l
NO_3-NO_2-N	3.60	mg/l
Phosphate Total	3.3	mg/l
Chloride	27.	mg/l
Sulphate	48	mg/l
Coliform Group	1100	per 100 ml
Fecal Coliform	0	per 100 ml

APPENDIX C

GEOLOGIC LOG

LOCATION: Melita Waste Disposal Site

TEST HOLE IDENTIFICATION: M.W. 1

DATE: Oct. 26, 1985

TOTAL DEPTH: 9.09 Metres

WATER TABLE: 2.42 Metres

TYPE OF CASING: PVC 1.5 Inch Sch. 40

TYPE OF SCREEN: Polypropylene Weave

SLOTTING LENGTH: 6-9 metres

FILL MATERIAL: Silica sand, 30-40 grade

DEPTH (METRES)	DESCRIPTION
0 - .30	sandy topsoil
.30 - 3.03	sand, med. brown, wet
3.03 - 4.24	gravel, med., wet
4.24 - 9.09	clay till, firm, dry.

GEOLOGIC LOG

LOCATION: Melita Waste Disposal Site

TEST HOLE IDENTIFICATION: M.W. 2

DATE: Oct. 26, 1985

TOTAL DEPTH: 9.09 Metres

WATER TABLE: 2.72 Metres

TYPE OF CASING: PVC 1.5 Inch Sch. 40

TYPE OF SCREEN: Polypropylene Weave

SLOTTING LENGTH: 6-9 metres

FILL MATERIAL: Silica sand, 30-40 grade

DEPTH (METRES)	DESCRIPTION
0 - .30	sandy topsoil
.30 - 2.72	sand brown, med. with gravel
2.72 - 3.63	dirty grey gravel, wet
3.63 - 4.54	grey clay till, moist
4.54 - 9.09	silty clay till, dry.

GEOLOGIC LOG

LOCATION: Melita Waste Disposal Site

TEST HOLE IDENTIFICATION: M.W. 3

DATE: Oct. 26, 1985

TOTAL DEPTH: 9.09 Metres

WATER TABLE: 2.42 Metres

TYPE OF CASING: PVC 1.5 Inch Sch. 40

TYPE OF SCREEN: Polypropylene Weave

SLOTTING LENGTH: 6-9 metres

FILL MATERIAL: Silica sand, 30-40 grade

DEPTH (METRES)	DESCRIPTION
0 - .30	sandy topsoil
.30 - 3.63	coarse sand with some gravel, wet
3.63 - 6.06	grey clay till, moist
6.06 - 2.42	silty clay till, dry.

CHAPTER - TWELVE -

NEEPAWA

R.M. OF LANGFORD

SE 34-14-15W

12 NEEPAWA WASTE DISPOSAL SITE

12.1 RECONNAISSANCE DATA

12.1.1 LOCATION

The Town of Neepawa is located in the R.M. of Langford and is approximately 60 kilometres northeast of Brandon along P.T.H. 16. The waste disposal site is located approximately 300 metres east of the town on Section SE 34-14-15W. (See Figures 12.1 and 12.2 in Appendix A).

12.1.2 BACKGROUND

This waste disposal site has been operating in its present location for over ten years. In 1977 the site was registered with the Province as an existing waste disposal ground. Present records show that this site serves approximately 3550 people. Primarily municipal waste from the Town of Neepawa and household waste from the surrounding rural areas are deposited at this site. A surficial dumping terrace and trench are in use to dispose of garbage, while bulky metallic, tree and construction wastes are deposited in an above grade area on the north side of the site. The town water supply is derived from the site and is treated before distribution. Rural residents located near the site derive water from the surficial sand aquifer.

12.1.3 SITE CONDITIONS

During the site inspection on July 22, 1985, several observations were made. The site is located two kilometres east of the town, directly off of a north-south running section road. The site is approximately 160 by 220 metres in size with an active area consisting of a agricultural chemical container compound, a drive in loop, with a dumping terrace on the outside of this loop, approximately 80 metres long, and 2 metres high. Also, several trenches are located on the west side of the site approximately 30 by 2 by 2 metres.

Waste is deposited in trenches, and on the edge of the dumping terrace and burned, followed by fill covering. The large bulky metallic, tree, and construction waste area, is located on the north end of the site and is approximately 30 by 30 metres in size.

The site is fenced, with a gate, and is in good condition. The site location is good, as the nearest residence is located 400 metres to the south.

12.1.4 PHYSIOGRAPHY

The site area is located on the Western Uplands, Upper Assiniboine Delta region. The area is characterized by the Whitemud River Valley in which the Whitemud River meanders, located less then 1 kilometre northwest of the site. The Whitemud River has incised itself approximately 15-20 metres below the level of the surrounding prairie level.

The surrounding region consists of gently rolling sand flats, formed as ice marginal and deltaic deposits. Drainage in the area is towards the Whitemud river valley, as runoff, via small drainage channels, and as subsurface flow. Land use around the site is agricultural, with few trees, most of which are located on the steepened slopes of the Whitemud River Valley.

12.1.5 DRILLING AND SAMPLING

A drilling and sampling program was undertaken for this site. Four monitoring wells were installed and water samples taken, as well as two river water samples. Analytical results of the water samples can be found in Appendix B, while drill logs can be found in Appendix C.

12.2 GEOLOGIC DATA

12.2.1 GEOLOGIC SETTING

The site area is located at the edge of the Ancient Proglacial Lake Agassiz basin, at the western boundary of the Ancient Assiniboine Delta, in an area of ice marginal and alluvial deposits. (See Figure 12.3 and 12.4 in Appendix A).

12.2.2 BEDROCK

Bedrock underlying this site at approximately 60 metres consists of shale and sandstone of the Cretaceous Period.

12.2.3 OVERBURDEN

Two units form approximately 60 metres of overburden in the site area. The lower unit consists of approximately 56 metres of glacial till exhibiting varying permeabilities. The upper unit consists of approximately 3 metres of interbedded sand silt and clay, lacustrine in origin, with permeability varying from good to poor, in the sand and silt respectively.

12.2.4 GEOHYDROLOGY

The shale bedrock aquifer is reported salty and unpotable in the site area. The only source of fresh water is from the Whitemud River and the shallow surficial sand aquifer. Groundwater flow regionally is to the east, however in the site area, groundwater flow is suspected to be northwesterly, towards the Whitemud River Valley.

12.3 ENVIRONMENTAL INTERPRETATION AND ASSESSMENT

12.3.1 LEACHATE HYDROLOGY

The sand unit beneath the disposal site forms a moderate size aquifer in the area and is pollution sensitive. Leachates generated by infiltrating precipitation permeating through the waste can migrate freely to the water table.

It is anticipated that, during times of snowmelt and major precipitation, local contamination of the groundwater can occur.

12.3.2 METHANE

Based on the amount of waste deposited on this site an estimated 10 million cubic metres of methane gas may be generated per year. Since the majority of waste is burned before burial the actual suspected quantity of methane gas produced will only be a fraction of the estimate. Migration distance of any methane gas generated should be limited to approximately 40 metres, based on the soil conditions.

12.3.3 WATER QUALITY

Water samples were taken from the four monitoring wells, and an upstream and downstream water sample was taken from the Whitemud River as well. Analytical results of the four monitoring well samples show no evidence of contamination, the results of the upstream monitoring well samples and three downstream monitoring well samples are all similar and within the Canadian drinking water standards.

The two river sample results were also similar and within the Canadian drinking water standards, as well.

12.3.4 CONCLUSION

Based on the available data to date, this site poses a low environmental impact on the area. Bedrock contamination is of low concern as this water is unpotable, and no contamination of the surficial aquifer was found. The site is generally well run and site location is good as any contamination that may occur would not affect any residential wells in the area.

12.3.5 RECOMMENDATIONS

1. A regular sampling program of the monitoring wells be initiated.

APPENDIX A

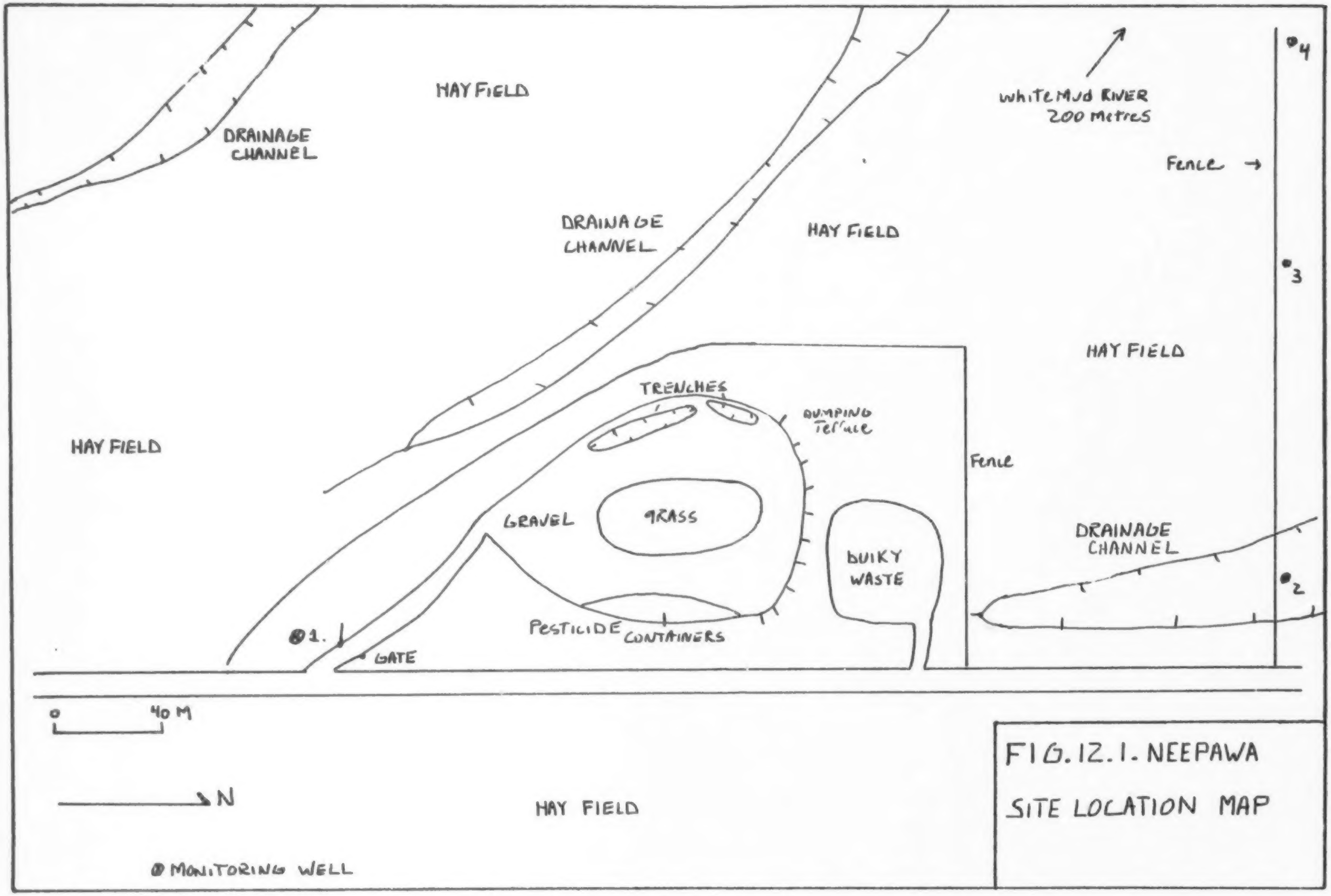

HAY FIELD
DRAINAGE CHANNEL
HAY FIELD
DRAINAGE CHANNEL
HAY FIELD
WHITEMUD RIVER 200 METRES
FENCE →
4
3
HAY FIELD
TRENCHES
DUMPING TERRACE
FENCE
GRAVEL
GRASS
BULKY WASTE
DRAINAGE CHANNEL
2
1.
GATE
PESTICIDE CONTAINERS
0
40 M
N
HAY FIELD
MONITORING WELL

FIG. 12.1. NEEPAWA SITE LOCATION MAP

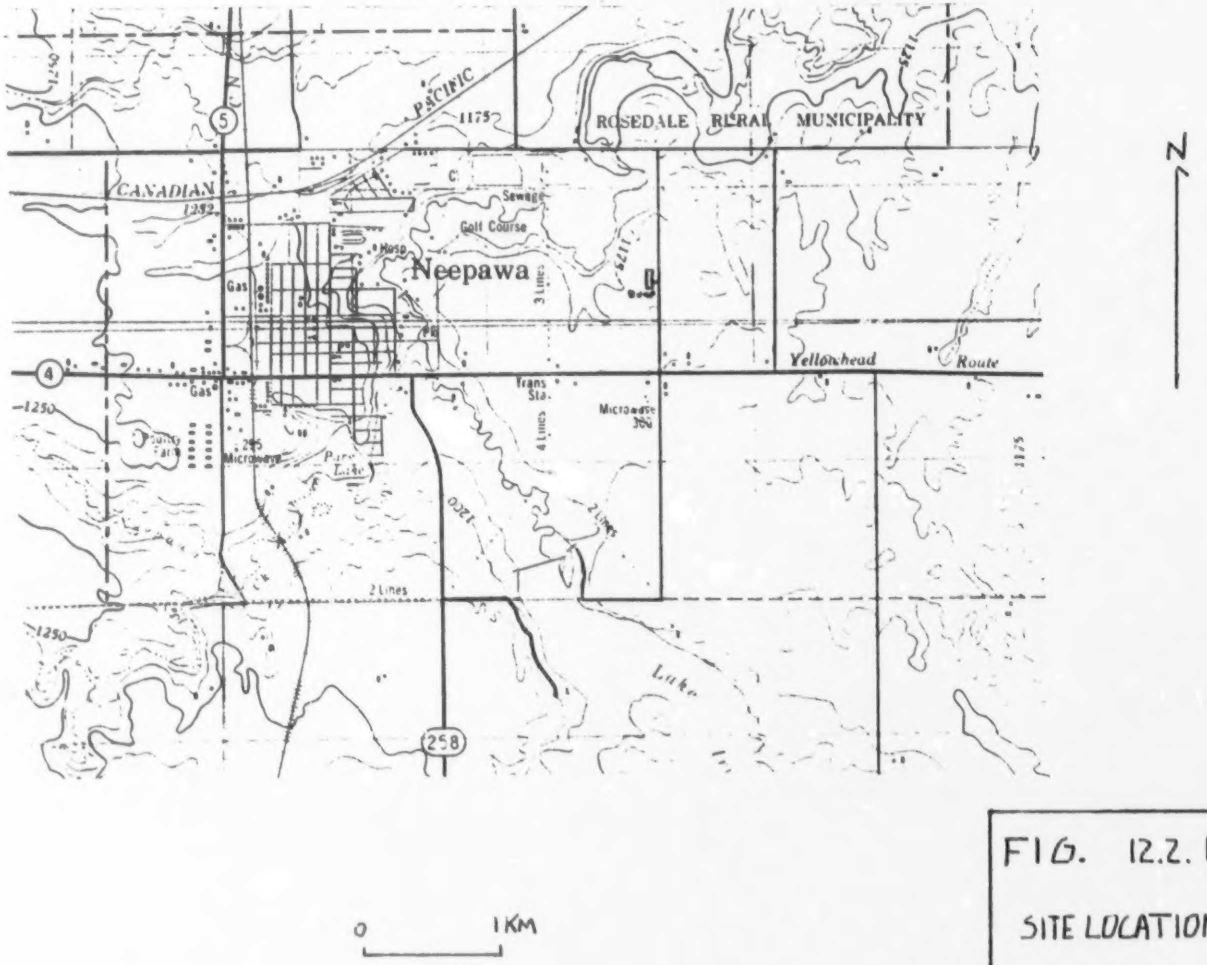

N
ROSEDALE RURAL MUNICIPALITY
PACIFIC
CANADIAN
1175
1125
1250
1282
Sewage
Golf Course
Hosp.
Neepawa
3 Lines
Gas
5
4
Yellowhead
Route
Trans Sta.
Microwave 360
4 Lines
Microwave
295
Park Lake
1200
2 Lines
1250
Lake
258
0
1KM

FIG. 12.2. NEEPAWA

SITE LOCATION MAP

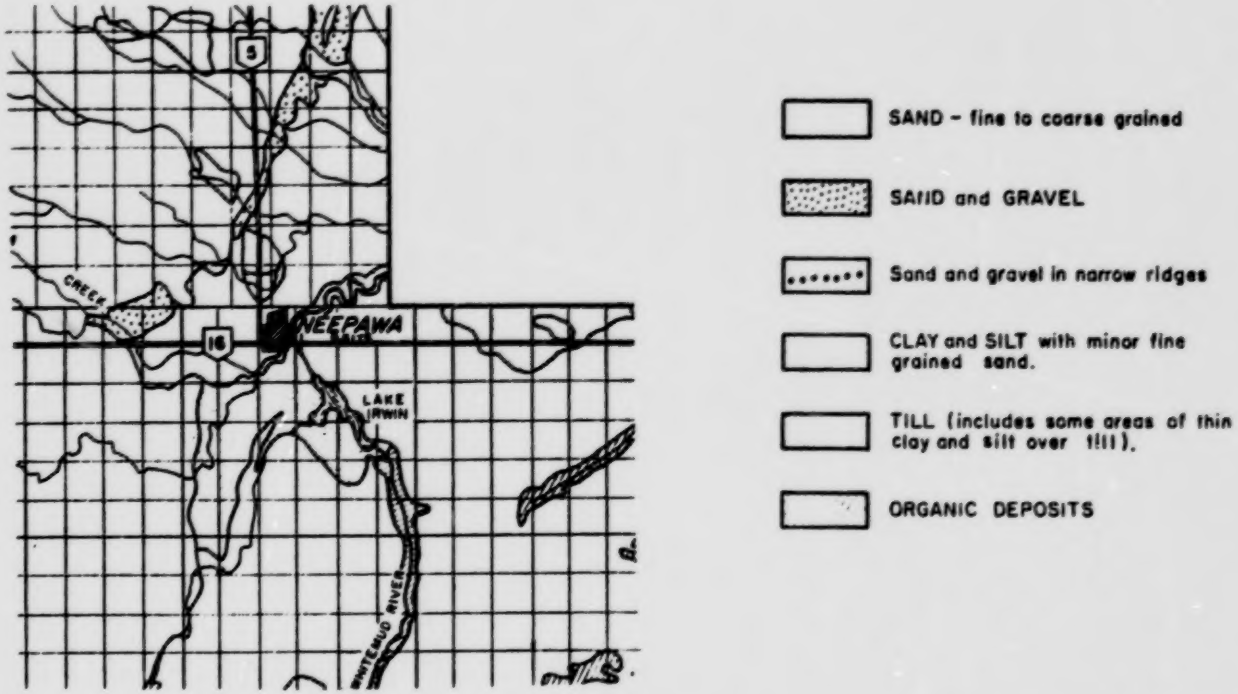

5
16
NEEPAWA
CREEK
LAKE IRWIN
WHITEMUD RIVER
SAND - fine to coarse grained
SAND and GRAVEL
Sand and gravel in narrow ridges
CLAY and SILT with minor fine grained sand.
TILL (includes some areas of thin clay and silt over till).
ORGANIC DEPOSITS

FIG. 12.3. NEEPAWA

SURFICIAL DEPOSITS

MAP

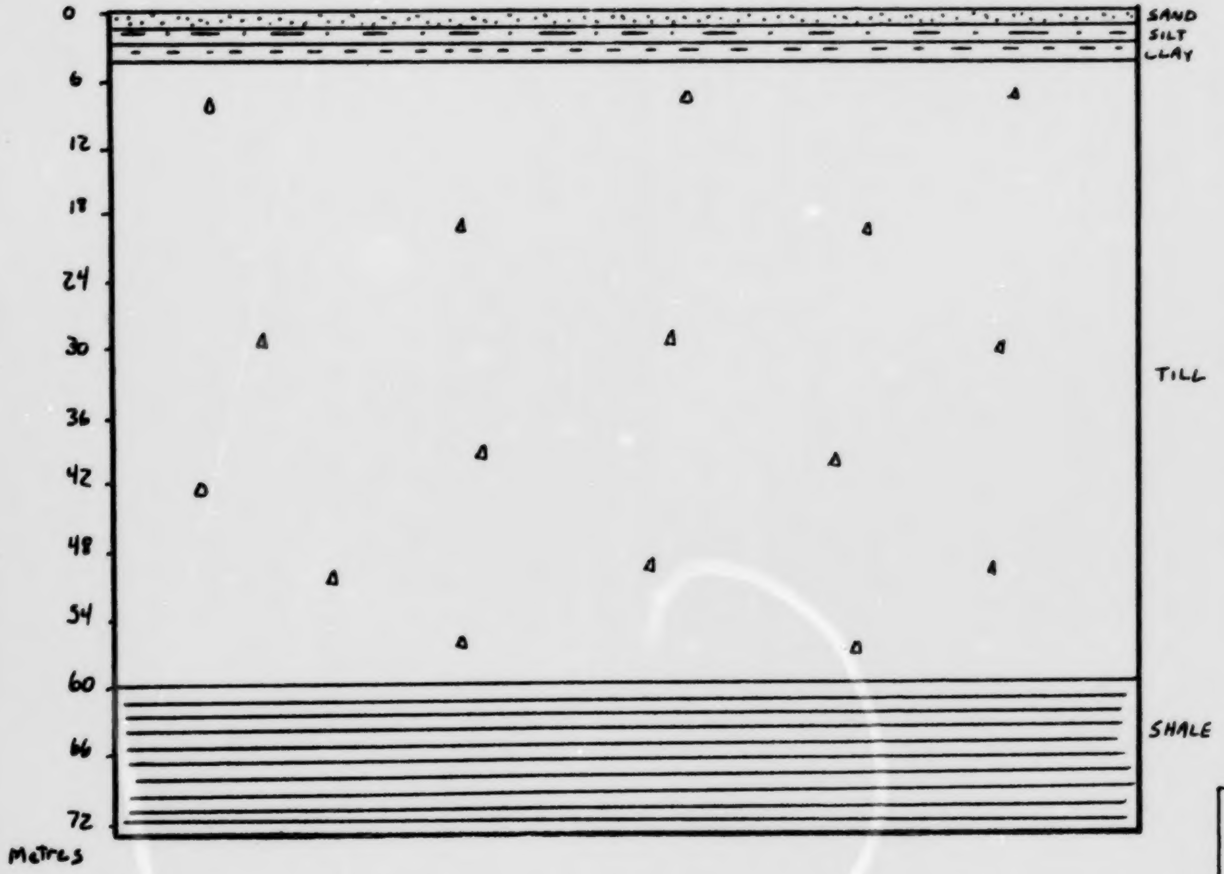

0
6
12
18
24
30
36
42
48
54
60
66
72
Metres
SAND
SILT
CLAY
TILL
SHALE

FIG.12.4. NEEPAWA GEOLOGIC CROSS SECTION

APPENDIX B

WATER QUALITY ANALYSIS

LOCATION: Neepawa
SAMPLE #: Monitoring Well One
DATE: October 30, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	631	umho/cm
Residue Total	490	mg/l
Residue Filterable	410	mg/l
Residue Non Filterable	82	mg/l
pH	7.55	units
Alkalinity Total ($CaCO_3$)	300.	mg/l
Alkalinity (HCO_3)	366.	mg/l
Alkalinity (CO_3)	0	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	.005	mg/l
Cadmium (Ext)	<.001	mg/l
Copper (Ext)	<.01	mg/l
Lead (Ext)	<.005	mg/l
Nickel (Ext)	.008	mg/l
Zinc (Ext)	.02	mg/l
Chromium (Ext)	<.005	mg/l
Calcium (Ext)	99.2	mg/l
Magnesium (Ext)	31.6	mg/l
Hardness ($CaCO_3$)	378	mg/l
Manganese (Ext)	.62	mg/l
Iron (Ext)	2.04	mg/l
Potassium (Ext)	<5.00	mg/l
Sodium	7.11	mg/l
COD	13	mg/l
TOC	–	mg/l
Turbidity	30.	NTU
CN (Total)	–	mg/l
Kjeldhal, Total, -N	.60	mg/l
NH_3-N. Sol.	.06	mg/l
NO_3-NO_2-N	2.20	mg/l
Phosphate Total	.075	mg/l
Chloride	3.0	mg/l
Sulphate	35.	mg/l
Coliform Group	9	per 100 ml
Fecal Coliform	0	per 100 ml

WATER QUALITY ANALYSIS

LOCATION: Neepawa
SAMPLE #: Monitoring Well Two
DATE: October 30, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	706	umho/cm
Residue Total	540	mg/l
Residue Filterable	430	mg/l
Residue Non Filterable	110	mg/l
pH	7.35	units
Alkalinity Total ($CaCO_3$)	358	mg/l
Alkalinity (HCO_3)	437	mg/l
Alkalinity (CO_3)	0	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	.004	mg/l
Cadmium (Ext)	<.001	mg/l
Copper (Ext)	.01	mg/l
Lead (Ext)	.009	mg/l
Nickel (Ext)	.008	mg/l
Zinc (Ext)	.04	mg/l
Chromium (Ext)	.005	mg/l
Calcium (Ext)	114	mg/l
Magnesium (Ext)	34.9	mg/l
Hardness ($CaCO_3$)	429	mg/l
Manganese (Ext)	.31	mg/l
Iron (Ext)	1.68	mg/l
Potassium (Ext)	<5.00	mg/l
Sodium	5.29	mg/l
COD	17	mg/l
TOC	-	mg/l
Turbidity	35	NTU
CN (Total)	-	mg/l
Kjeldhal, Total, -N	.45	mg/l
NH_3-N. Sol.	.02	mg/l
NO_3-NO_2-N	.13	mg/l
Phosphate Total	.11	mg/l
Chloride	13.	mg/l
Sulphate	35.	mg/l
Coliform Group	4	per 100 ml
Fecal Coliform	0	per 100 ml

WATER QUALITY ANALYSIS

LOCATION: Neepawa
SAMPLE #: Monitoring Well Three
DATE: October 30, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	760	umho/cm
Residue Total	860	mg/l
Residue Filterable	500	mg/l
Residue Non Filterable	360	mg/l
pH	7.65	units
Alkalinity Total ($CaCO_3$)	332	mg/l
Alkalinity (HCO_3)	405	mg/l
Alkalinity (CO_3)	0	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	.009	mg/l
Cadmium (Ext)	<.001	mg/l
Copper (Ext)	.01	mg/l
Lead (Ext)	.007	mg/l
Nickel (Ext)	.032	mg/l
Zinc (Ext)	.04	mg/l
Chromium (Ext)	.012	mg/l
Calcium (Ext)	137	mg/l
Magnesium (Ext)	42.4	mg/l
Hardness ($CaCO_3$)	517	mg/l
Manganese (Ext)	.42	mg/l
Iron (Ext)	.68	mg/l
Potassium (Ext)	<5.00	mg/l
Sodium	4.38	mg/l
COD	24	mg/l
TOC	-	mg/l
Turbidity	125	NTU
CN (Total)	-	mg/l
Kjeldhal, Total, -N	.40	mg/l
NH_3-N. Sol.	.02	mg/l
NO_3-NO_2-N	.15	mg/l
Phosphate Total	.28	mg/l
Chloride	11.	mg/l
Sulphate	85.	mg/l
Coliform Group	7	per 100 ml
Fecal Coliform	0	per 100 ml

WATER QUALITY ANALYSIS

LOCATION: Neepawa

SAMPLE #: Monitoring Well Four

DATE: October 30, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	706	umho/cm
Residue Total	4280	mg/l
Residue Filterable	730	mg/l
Residue Non Filterable	3550.	mg/l
pH	7.60	units
Alkalinity Total ($CaCO_3$)	346	mg/l
Alkalinity (HCO_3)	422	mg/l
Alkalinity (CO_3)	0	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	.008	mg/l
Cadmium (Ext)	<.001	mg/l
Copper (Ext)	.01	mg/l
Lead (Ext)	.011	mg/l
Nickel (Ext)	.014	mg/l
Zinc (Ext)	.04	mg/l
Chromium (Ext)	.010	mg/l
Calcium (Ext)	129	mg/l
Magnesium (Ext)	45.4	mg/l
Hardness ($CaCO_3$)	509	mg/l
Manganese (Ext)	.41	mg/l
Iron (Ext)	4.14	mg/l
Potassium (Ext)	<5.00	mg/l
Sodium	3.54	mg/l
COD	19	mg/l
TOC	-	mg/l
Turbidity	2000	NTU
CN (Total)	-	mg/l
Kjeldhal, Total, -N	.50	mg/l
NH_3-N. Sol.	.02	mg/l
NO_3-NO_2-N	6.20	mg/l
Phosphate Total	3.3	mg/l
Chloride	15.	mg/l
Sulphate	38.	mg/l
Coliform Group	15.	per 100 ml
Fecal Coliform	0	per 100 ml

WATER QUALITY ANALYSIS

LOCATION: Neepawa
SAMPLE #: River - Upstream
DATE: September 11, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	459	umho/cm
Residue Total	330	mg/l
Residue Filterable	270	mg/l
Residue Non Filterable	66	mg/l
pH	7.95	units
Alkalinity Total ($CaCO_3$)	206	mg/l
Alkalinity (HCO_3)	251	mg/l
Alkalinity (CO_3)	0	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	.017	mg/l
Cadmium (Ext)	<.001	mg/l
Copper (Ext)	<.01	mg/l
Lead (Ext)	<.005	mg/l
Nickel (Ext)	<.005	mg/l
Zinc (Ext)	.01	mg/l
Chromium (Ext)	<.005	mg/l
Calcium (Ext)	55.8	mg/l
Magnesium (Ext)	29.3	mg/l
Hardness ($CaCO_3$)	260	mg/l
Manganese (Ext)	.51	mg/l
Iron (Ext)	2.16	mg/l
Potassium (Ext)	<5.00	mg/l
Sodium	11.1	mg/l
COD	37	mg/l
TOC	-	mg/l
Turbidity	10	NTU
CN (Total)	<.02	mg/l
Kjeldhal, Total, -N	.90	mg/l
NH_3-N. Sol.	.05	mg/l
NO_3-NO_2-N	.12	mg/l
Phosphate Total	.15	mg/l
Chloride	8	mg/l
Sulphate	32	mg/l
Coliform Group	24000	per 100 ml
Fecal Coliform	2400	per 100 ml

WATER QUALITY ANALYSIS

LOCATION: Neepawa
SAMPLE #: River - Downstream
DATE: September 11, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	371	umho/cm
Residue Total	250	mg/l
Residue Filterable	220	mg/l
Residue Non Filterable	28	mg/l
pH	8.05	units
Alkalinity Total ($CaCO_3$)	194	mg/l
Alkalinity (HCO_3)	237	mg/l
Alkalinity (CO_3)	0	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	.023	mg/l
Cadmium (Ext)	<.001	mg/l
Copper (Ext)	<.01	mg/l
Lead (Ext)	<.005	mg/l
Nickel (Ext)	.005	mg/l
Zinc (Ext)	<.01	mg/l
Chromium (Ext)	<.005	mg/l
Calcium (Ext)	45.6	mg/l
Magnesium (Ext)	23.5	mg/l
Hardness ($CaCO_3$)	211	mg/l
Manganese (Ext)	.56	mg/l
Iron (Ext)	1.49	mg/l
Potassium (Ext)	<5.00	mg/l
Sodium	5.7	mg/l
COD	35	mg/l
TOC	-	mg/l
Turbidity	6.5	NTU
CN (Total)	<.02	mg/l
Kjeldhal, Total, -N	1.6	mg/l
NH_3-N. Sol.	<.02	mg/l
NO_3-NO_2-N	<.01	mg/l
Phosphate Total	.39	mg/l
Chloride	340	mg/l
Sulphate	680	mg/l
Coliform Group	93	per 100 ml
Fecal Coliform	43	per 100 ml

APPENDIX C

GEOLOGIC LOG

LOCATION: Neepawa Waste Disposal Site

TEST HOLE IDENTIFICATION: M.W. 1

DATE: Oct. 24, 1985

TOTAL DEPTH: 6.06 Metres

WATER TABLE: 2.12 Metres

TYPE OF CASING: PVC 1.5 Inch Sch. 40

TYPE OF SCREEN: Polypropylene Weave

SLOTTING LENGTH: 3-6 metres

FILL MATERIAL: Silica sand, 30-40 grade

DEPTH (METRES)	DESCRIPTION
0 - 1.51	fine brown sand
1.51 - 3.63	clayey silt brown, wet
3.63 - 4.24	clayey silt grey, wet
4.24 - 4.54	S.A.A. with higher clay content, wet
4.54 - 5.45	silty clay, wet
5.45 - 6.06	clay, plastic, firm, dry.

GEOLOGIC LOG

LOCATION: Neepawa Waste Disposal Site

TEST HOLE IDENTIFICATION: M.W. 2

DATE: Oct. 24, 1985

TOTAL DEPTH: 6.06 Metres

WATER TABLE: 2.42 Metres

TYPE OF CASING: PVC 1.5 Inch Sch. 40

TYPE OF SCREEN: Polypropylene Weave

SLOTTING LENGTH: 3-6 metres

FILL MATERIAL: Silica sand, 30-40 grade

DEPTH (METRES)	DESCRIPTION
0 - .30	fine sandy topsoil
.30 - 1.51	fine brown sand
1.51 - 4.24	clayey silt, wet
4.24 - 4.54	silty clay, wet
4.54 - 6.06	plastic, firm, clay, dry.

GEOLOGIC LOG

LOCATION: Neepawa Waste Disposal Site

TEST HOLE IDENTIFICATION: M.W. 3

DATE: Oct. 24, 1985

TOTAL DEPTH: 4.54 Metres

WATER TABLE: 2.42 Metres

TYPE OF CASING: PVC 1.5 Inch Sch. 40

TYPE OF SCREEN: Polypropylene Weave

SLOTTING LENGTH: 1.5-4.5 metres

FILL MATERIAL: Silica sand, 30-40 grade

DEPTH (METRES)	DESCRIPTION
0 - .30	organic silt topsoil
.30 - 1.51	clayey silt
1.51 - 3.93	S.A.A. less clay, wet
3.93 - 4.54	clay, firm, dry.

GEOLOGIC LOG

LOCATION: Neepawa Waste Disposal Site

TEST HOLE IDENTIFICATION: M.W. 4

DATE: Oct. 24, 1985

TOTAL DEPTH: 6.06 Metres

WATER TABLE: 1.51 Metres

TYPE OF CASING: PVC 1.5 Inch Sch. 40

TYPE OF SCREEN: Polypropylene Weave

SLOTTING LENGTH: 3.6 metres

FILL MATERIAL: Silica sand, 30-40 grade

DEPTH (METRES)	DESCRIPTION
0 - .60	clayey topsoil
.60 - 1.51	clayey silt
1.51 - 3.03	silty sand, wet
3.03 - 6.06	clay, grey, firm, dry.

CHAPTER - THIRTEEN -

ROBLIN

R.M. OF SHELL RIVER

SE 20-26-28W

13 ROBLIN WASTE DISPOSAL SITE

13.1 RECONNAISSANCE DATA

13.1.1 LOCATION

The Town of Roblin is located approximately 180 kilometres northwest of Brandon along P.T.H. 83. The waste disposal site is located approximately 4 kilometres north of the town on Section SE 20-26-28W. (See Figure 13.1 and 13.2 in Appendix A).

13.1.2 BACKGROUND

This waste disposal site has been operating in its present location for over 15 years. In 1977 the site was registered with the Province as an existing waste disposal ground. Current records show that this site serves approximately 2000 people. Primarily municipal waste from the Town of Roblin and household waste from surrounding rural residents is deposited at this site. An open pit system is used. There is a separate disposal area for agricultural chemical containers, and a separate pit for sewage disposal.

Area residents derive water from the shallow sand aquifer. Town water supply is obtained from deep wells and distributed.

13.1.3 SITE CONDITIONS

During the site inspection on September 5, 1985, several observations were made. The site is located 4 kilometres north of the town, and 340 metres west of P.T.H. 83. The site is approximately 90 metres by 240 metres in size with an active area of approximately 70 metres by 60 metres consisting of a pit approximately 2 metres deep and 40 metres in diameter. A separate agricultural chemical container compound is located north of the pit. A sewage liquid facility is located on the extreme north end of the site consisting of a trench approximately 4 by 4 by 2 metres deep. The trench is located in clay soil.

Waste is deposited in the pit, along with tree waste, and bulky metallic waste and burned. The site is fenced with a page wire fence, with access to the site from an all weather road. A gravel pit is located directly east of the site. Site location is good, as it is located on impermeable clay deposits and is located over 400 metres from the nearest residence. Site condition is also good, however, the site appears to be approaching capacity.

13.1.4 PHYSIOGRAPHY

The site area is located in the western part of the Western Uplands on the Minnedosa-Reston till plain. The major feature of this area is the Assiniboine River Valley incised into the till to varying depths, and the stagnation hummockies located on the till plain, up to several metres in depth, forming small ponds and lakes.

The till plain features gently rolling till ridges, while the site area is located on the border of an outwash deposit, as seen by the adjacent gravel pit, located directly east of the site.

Land utilization in the area is basically agricultural, with large treed areas. Area drainage is towards the outwash deposit sands, directly east of the site.

13.1.5 DRILLING AND SAMPLING

A drilling and sampling program was undertaken for this site. Three area residences and one commercial building well were sampled. Three test holes were drilled on the site to ascertain the geologic conditions. Analytical results of water samples taken can be found in Appendix B, while geologic logs can be found in Appendix C.

13.2 GEOLOGIC DATA

13.2.1 GEOLOGIC SETTING

The site area is located on a till plain, which features stagnation hummockies in the impermeable till sediments. These hummockies form small lakes and ponds. The site itself is situated on the till plain, on the border of an outwash deposit consisting of sand and gravel several metres thick. (See Figure 13.3 and 13.4 in Appendix A).

13.2.2 BEDROCK

Bedrock underlies the site at a depth of approximately 90 metres and consists of shale of the Cretaceous Period.

13.2.3 OVERBURDEN

The overburden at the site location consists of approximately 90 metres of moderately calcareous till exhibiting variable permeabilities from very impermeable clay till to permeable sand lenses, located at varying depths.

13.2.4 GEOHYDROLOGY

The outwash deposits of sand and gravel located directly east of the site forms an unconfined surficial aquifer utilized by area residents. Groundwater flow in this aquifer is most likely southerly. The bedrock aquifer in this area is very deep and reported to be high in iron and manganese.

13.3 ENVIRONMENTAL INTERPRETATION AND ASSESSMENT

13.3.1 LEACHATE HYDROLOGY

Leachates are generated at this site during times of precipitation and high snowmelt. Since the site is located on impermeable sediments, migration of any leachates generated will be limited. It is suspected that excess runoff from the site, may enter the nearby unconfined aquifer. The bedrock aquifer should not be affected by any leachates from the site, because of the thick till layer. Intermittent sand lenses in the till are not likely affected by leachates, as the site is underlain by impermeable clay till.

13.3.2 METHANE

Based on the amount of waste deposited at this site an estimated 10 million cubic metres of methane gas may be generated per year. Since the majority of waste is burned before burial, the actual suspected quantity of methane gas produced will only be a fraction of the estimate. Migration distance of any methane gas generated should be limited to approximately 30 metres, based on soil conditions.

13.3.3 WATER QUALITY

Water samples were taken from three residences and one commercial building located near the site. Analytical results of these water samples show all parameters to be within the recommended guidelines of the Canadian drinking water standards, except for a high nitrate parameter in the commercial building well sample, which is likely caused by the cattle operations on site.

13.3.4 CONCLUSION

Based on the available data to date the environmental impact of the site is low. Contamination of the surficial aquifer located adjacent to the site was not found, and, the wells located near the site show no signs of contamination. The site operation and location are good and the site well kept. Currently the site is approaching its capacity, and will have to be relocated in the future.

13.3.5 RECOMMENDATIONS

1. Area wells should be resampled.
2. If possible a bulky metallic waste disposal area be established.

APPENDIX A

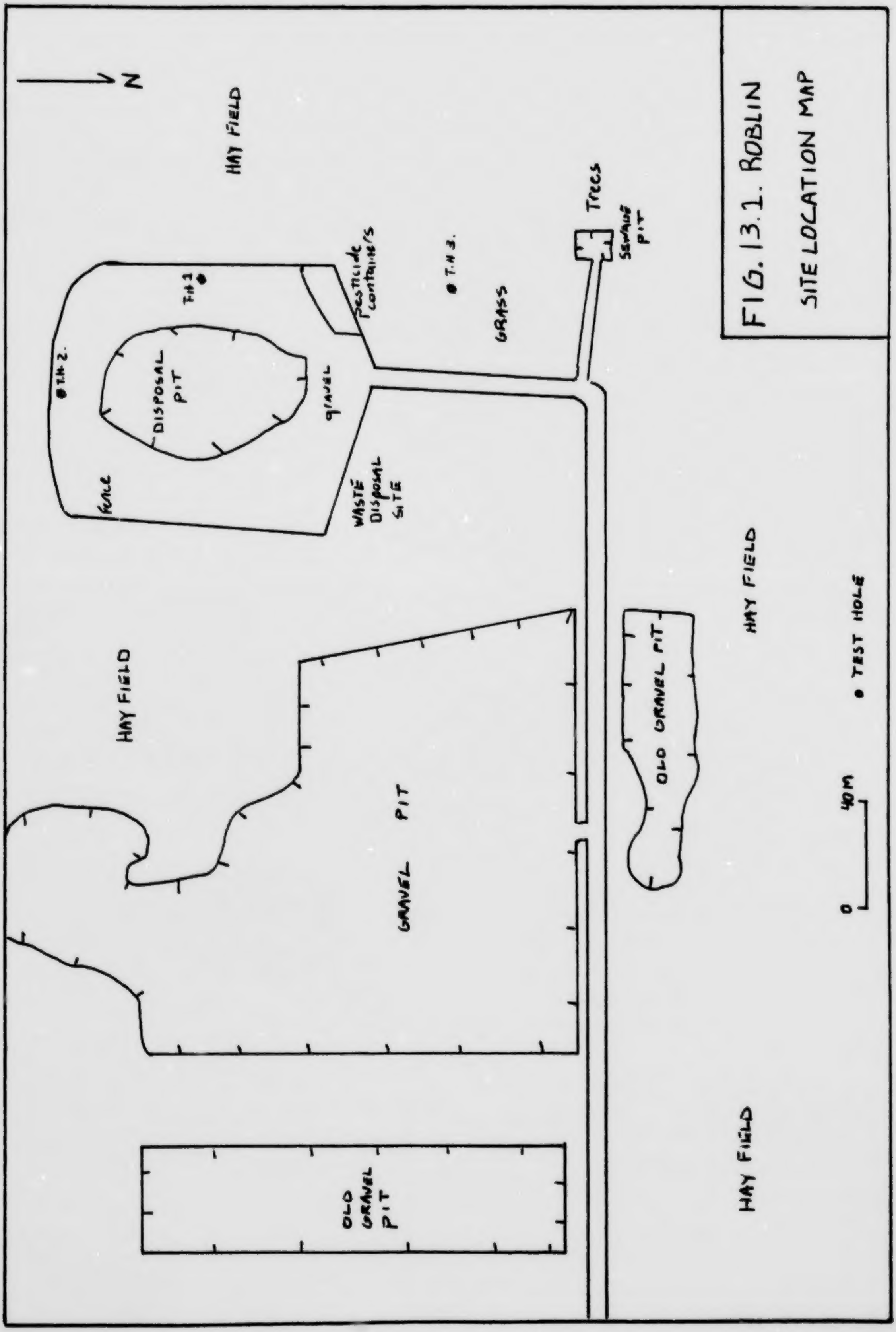
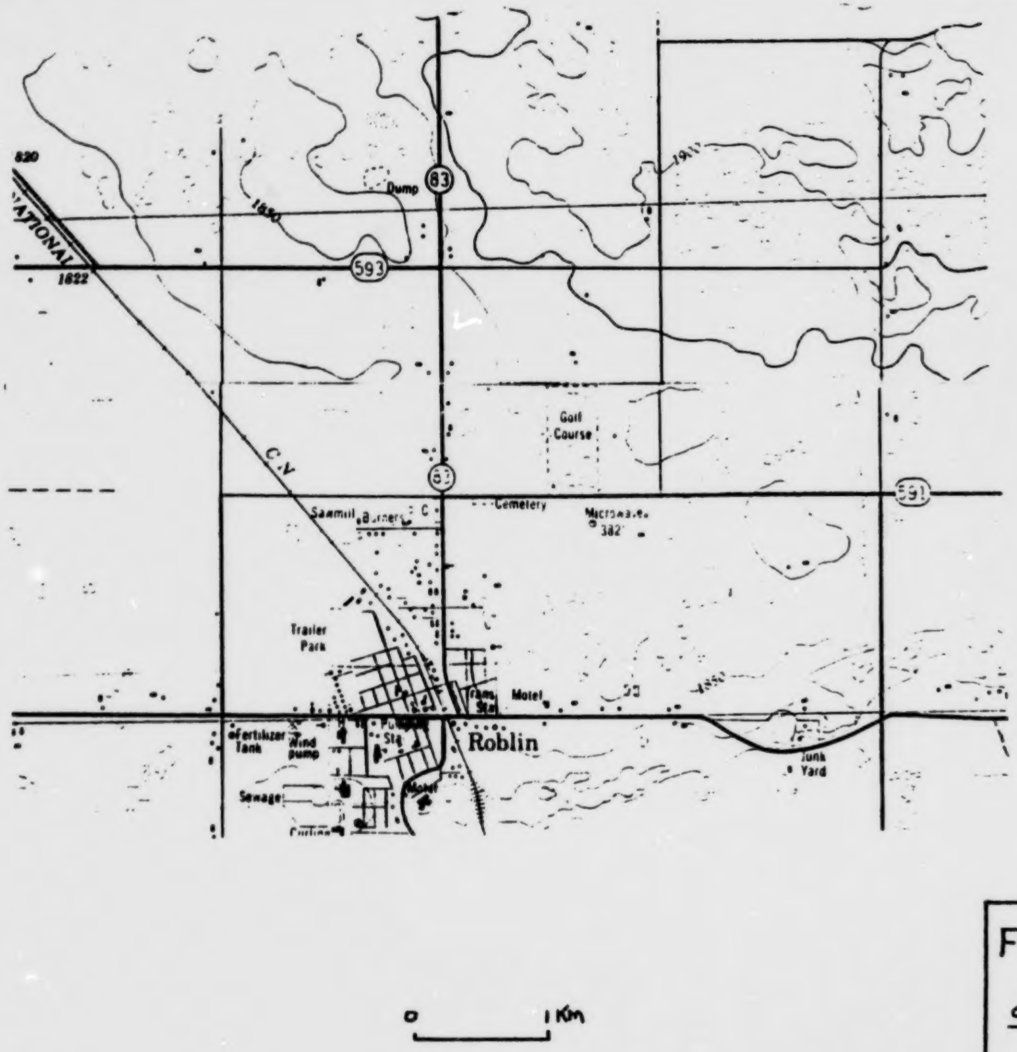

N
HAY FIELD
T.H.1
T.H.2.
T.H.3.
Pesticide containers
Trees
SEWAGE PIT
GRASS
DISPOSAL PIT
gravel
fence
WASTE DISPOSAL SITE
HAY FIELD
GRAVEL PIT
OLD GRAVEL PIT
HAY FIELD
OLD GRAVEL PIT
HAY FIELD
• TEST HOLE
0
40m

FIG. 13.1. ROBLIN SITE LOCATION MAP



820
NATIONAL
1822
1850
Dump
83
593
Golf Course
C.N
83
Sawmill Burners
C
Cemetery
Microwave
382
591
Trailer Park
Trans. Sta
Motel
Roblin
Fertilizer Tank
Wind pump
Pumping Sta
Sewage
Curling
Motel
Junk Yard
0
1 Km
N

FIG. 13.2. ROBLIN

SITE LOCATION MAP

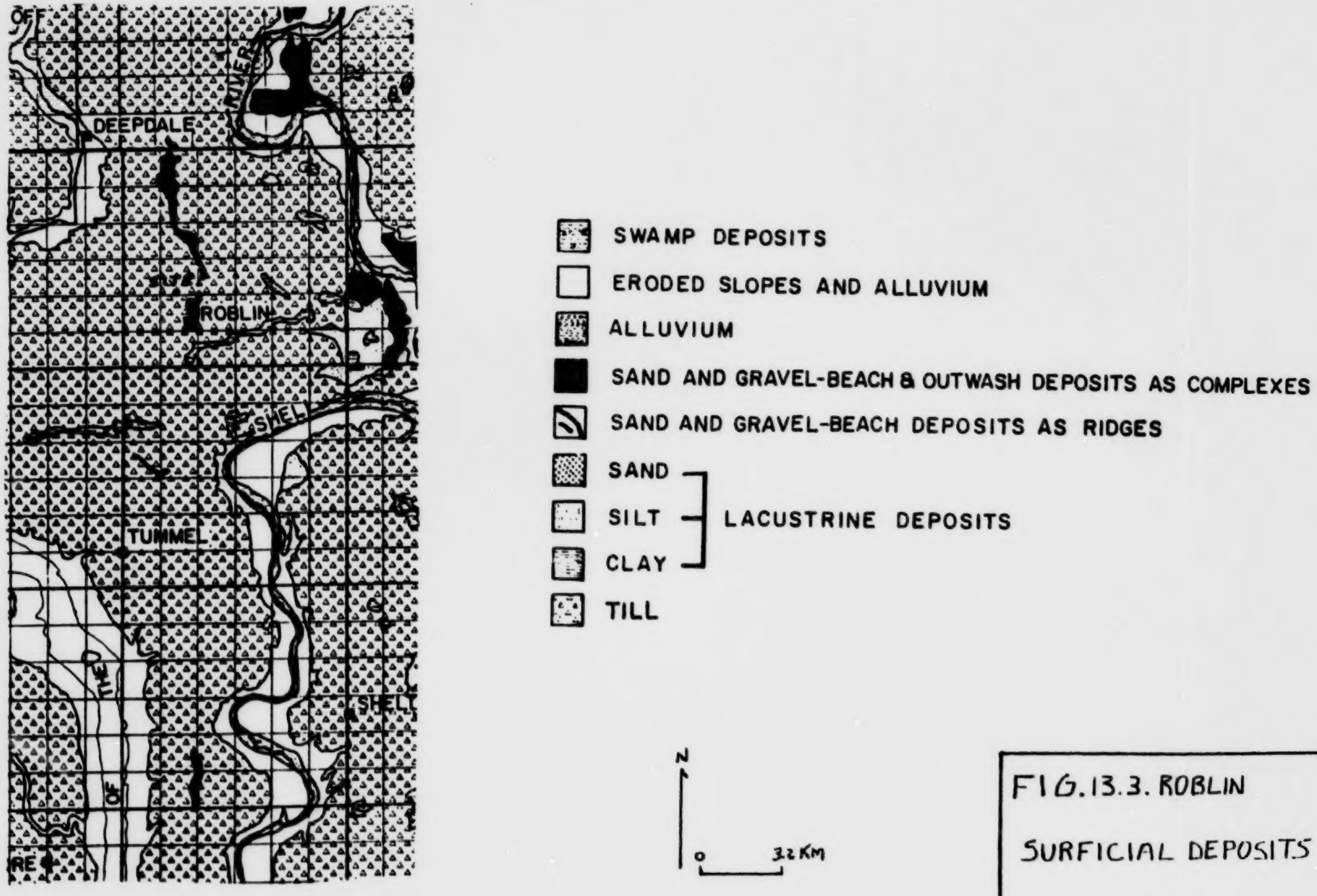

OFF
RIVER
DEEPDALE
ROBLIN
SHEL
TUMMEL
THE
OF
SHEL
RE
▨ SWAMP DEPOSITS
☐ ERODED SLOPES AND ALLUVIUM
▨ ALLUVIUM
■ SAND AND GRAVEL-BEACH & OUTWASH DEPOSITS AS COMPLEXES
▨ SAND AND GRAVEL-BEACH DEPOSITS AS RIDGES
▨ SAND
▨ SILT
▨ CLAY
LACUSTRINE DEPOSITS
▨ TILL
N
0
3.2 KM

FIG. 13.3. ROBLIN
SURFICIAL DEPOSITS
MAP

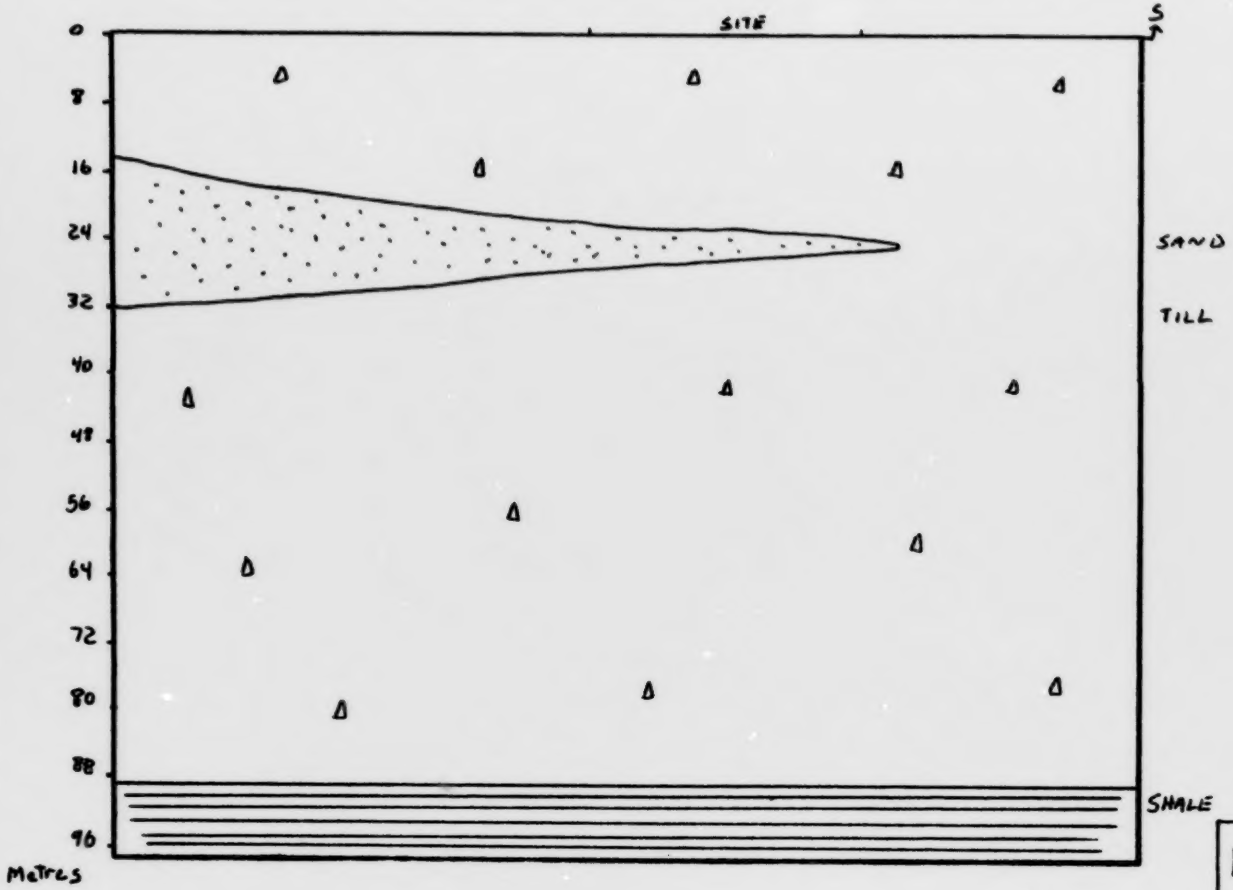

SITE
S
SAND
TILL
SHALE
0
8
16
24
32
40
48
56
64
72
80
88
96
Metres

FIG. 13.4. ROBLIN GEOLOGIC CROSS SECTION

APPENDIX B

WATER QUALITY ANALYSIS

LOCATION: Roblin
SAMPLE #: Residential Well One
DATE: October 8, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	1190	umho/cm
Residue Total	860	mg/l
Residue Filterable	860	mg/l
Residue Non Filterable	<5.	mg/l
pH	7.05	units
Alkalinity Total ($CaCO_3$)	436	mg/l
Alkalinity (HCO_3)	532	mg/l
Alkalinity (CO_3)	0	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	.001	mg/l
Cadmium (Ext)	<.001	mg/l
Copper (Ext)	.03	mg/l
Lead (Ext)	<.005	mg/l
Nickel (Ext)	<.005	mg/l
Zinc (Ext)	.04	mg/l
Chromium (Ext)	<.005	mg/l
Calcium (Ext)	180	mg/l
Magnesium (Ext)	66.1	mg/l
Hardness ($CaCO_3$)	722	mg/l
Manganese (Ext)	.15	mg/l
Iron (Ext)	.28	mg/l
Potassium (Ext)	7.5	mg/l
Sodium	7.35	mg/l
COD	46	mg/l
TOC	-	mg/l
Turbidity	1.5	NTU
CN (Total)	<.02	mg/l
Kjeldhal, Total, -N	.25	mg/l
NH_3-N. Sol.	<.02	mg/l
NO_3-NO_2-N	2.40	mg/l
Phosphate Total	<.01	mg/l
Chloride	18	mg/l
Sulphate	213	mg/l
Coliform Group	<1	per 100 ml
Fecal Coliform	<1	per 100 ml

WATER QUALITY ANALYSIS

LOCATION: Roblin

SAMPLE #: Residential Well Two

DATE: October 8, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	1310	umho/cm
Residue Total	930	mg/l
Residue Filterable	930	mg/l
Residue Non Filterable	<5.	mg/l
pH	7.05	units
Alkalinity Total ($CaCO_3$)	460	mg/l
Alkalinity (HCO_3)	561	mg/l
Alkalinity (CO_3)	0	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	<.001	mg/l
Cadmium (Ext)	<.001	mg/l
Copper (Ext)	.02	mg/l
Lead (Ext)	<.005	mg/l
Nickel (Ext)	<.005	mg/l
Zinc (Ext)	.04	mg/l
Chromium (Ext)	<.005	mg/l
Calcium (Ext)	195	mg/l
Magnesium (Ext)	69.	mg/l
Hardness ($CaCO_3$)	772	mg/l
Manganese (Ext)	.02	mg/l
Iron (Ext)	.02	mg/l
Potassium (Ext)	6.50	mg/l
Sodium	4.95	mg/l
COD	11	mg/l
TOC	–	mg/l
Turbidity	.25	NTU
CN (Total)	<.02	mg/l
Kjeldhal, Total, -N	.25	mg/l
NH_3-N. Sol.	<.02	mg/l
NO_3-NO_2-N	13.0	mg/l
Phosphate Total	<.010	mg/l
Chloride	24	mg/l
Sulphate	200	mg/l
Coliform Group	<1	per 100 ml
Fecal Coliform	<1	per 100 ml

WATER QUALITY ANALYSIS

LOCATION: Roblin
SAMPLE #: Residential Well Three
DATE: October 7, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	890	umho/cm
Residue Total	610	mg/l
Residue Filterable	610	mg/l
Residue Non Filterable	<5.	mg/l
pH	7.25	units
Alkalinity Total ($CaCO_3$)	338	mg/l
Alkalinity (HCO_3)	412	mg/l
Alkalinity (CO_3)	0	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	<.001	mg/l
Cadmium (Ext)	<.001	mg/l
Copper (Ext)	.06	mg/l
Lead (Ext)	<.005	mg/l
Nickel (Ext)	<.005	mg/l
Zinc (Ext)	1.08	mg/l
Chromium (Ext)	<.005	mg/l
Calcium (Ext)	130	mg/l
Magnesium (Ext)	43.7	mg/l
Hardness ($CaCO_3$)	505.	mg/l
Manganese (Ext)	<.02	mg/l
Iron (Ext)	<.02	mg/l
Potassium (Ext)	13.5	mg/l
Sodium	7.92	mg/l
COD	<10	mg/l
TOC	–	mg/l
Turbidity	.25	NTU
CN (Total)	<.02	mg/l
Kjeldhal, Total, -N	.20	mg/l
NH_3-N. Sol.	<.02	mg/l
NO_3-NO_2-N	3.30	mg/l
Phosphate Total	<.01	mg/l
Chloride	19	mg/l
Sulphate	115	mg/l
Coliform Group	1	per 100 ml
Fecal Coliform	<1	per 100 ml

WATER QUALITY ANALYSIS

LOCATION: Roblin

SAMPLE #: Residential Well Four

DATE: October 8, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	1120	umho/cm
Residue Total	810	mg/l
Residue Filterable	810	mg/l
Residue Non Filterable	<5.0	mg/l
pH	7.15	units
Alkalinity Total ($CaCO_3$)	352	mg/l
Alkalinity (HCO_3)	429	mg/l
Alkalinity (CO_3)	0	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	<.001	mg/l
Cadmium (Ext)	<.001	mg/l
Copper (Ext)	<.01	mg/l
Lead (Ext)	<.005	mg/l
Nickel (Ext)	<.005	mg/l
Zinc (Ext)	.04	mg/l
Chromium (Ext)	<.005	mg/l
Calcium (Ext)	147	mg/l
Magnesium (Ext)	55.0	mg/l
Hardness ($CaCO_3$)	594.	mg/l
Manganese (Ext)	.66	mg/l
Iron (Ext)	4.38	mg/l
Potassium (Ext)	6.00	mg/l
Sodium	29.9	mg/l
COD	<10	mg/l
TOC	-	mg/l
Turbidity	25	NTU
CN (Total)	<.02	mg/l
Kjeldhal, Total, -N	.36	mg/l
NH_3-N. Sol.	.09	mg/l
NO_3-NO_2-N	.01	mg/l
Phosphate Total	<.01	mg/l
Chloride	43	mg/l
Sulphate	210	mg/l
Coliform Group	<1	per 100 ml
Fecal Coliform	<1	per 100 ml

APPENDIX C

GEOLOGIC LOG

LOCATION: Roblin Waste Disposal Site
TEST HOLE IDENTIFICATION: T.H. 1
DATE: Oct. 26, 1985
TOTAL DEPTH: 11.2 Metres
WATER TABLE: 9.5 metres
TYPE OF CASING: N/A
TYPE OF SCREEN: N/A

DEPTH (METRES)	DESCRIPTION
0 - 1.51	clayey silty till
1.51 - 4.54	silty till
4.54 - 4.84	fine brown sand, dry
4.84 - 6.06	med. brown sand, dry
6.06 - 10.09	silty coarse sand with gravel, wet
10.09 - 11.2	clay, firm.

GEOLOGIC LOG

LOCATION: Roblin Waste Disposal Site

TEST HOLE IDENTIFICATION: T.H. 2

DATE: Oct. 26, 1985

TOTAL DEPTH: 6.06 Metres

WATER TABLE: N/A

TYPE OF CASING: N/A

TYPE OF SCREEN: N/A

DEPTH (METRES)	DESCRIPTION
0 - .60	silty clay till
.60 - 1.51	clayey silt
1.51 - 2.87	firm clay till with stones
2.87 - 4.54	silty sand till
4.54 - 6.06	gravely till.

GEOLOGIC LOG

LOCATION: Roblin Waste Disposal Site

TEST HOLE IDENTIFICATION: T.H. 3

DATE: Oct. 26, 1985

TOTAL DEPTH: 16.96 Metres

WATER TABLE: 13.6 Metres

TYPE OF CASING: N/A

TYPE OF SCREEN: N/A

DEPTH (METRES)	DESCRIPTION
0 - 4.84	silty clay till
4.84 - 9.09	dense blue clay till
9.09 - 9.39	coarse sandy gravel
9.39 - 10.30	silty clay till
10.30 - 12.12	oxidized gravel, dry
12.12 - 16.96	coarse sandy gravel, wet.

CHAPTER - FOURTEEN -

RUSSELL

R.M. OF RUSSELL

NW 27-20-28W

14 RUSSELL WASTE DISPOSAL SITE

14.1 RECONNAISSANCE DATA

14.1.1 LOCATION

The Town of Russell is located approximately 140 kilometres northwest of Brandon along P.T.H. 83. The waste disposal site is located 1.6 kilometres south of the town on Section 27-20-28W (see Figures 14.1 and 14.2 in Appendix A).

14.1.2 BACKGROUND

This waste disposal site has been operating in its present location for over ten years. In 1977 the site was registered with the Province as an existing waste disposal ground. Present records show that this site serves approximately 1600 people. Primarily municipal waste from the Town of Russell and household waste from surrounding rural areas are deposited at this site. A trench disposal system is in use for garbage and tree waste, while bulky metallic waste and agricultural chemical containers are placed on a separate site, and periodically picked up by a scrap metal dealer.

Water supply for the Town is derived from the Conjuring Creek and treated before distribution. Rural residents derive water from the shale bedrock aquifer.

14.1.3 SITE CONDITIONS

During the site inspection on September 5, 1985, several observations were made. The site is located 1.6 kilometres south of town. Access to the site is from an all weather road running west 800 metres from P.T.H. 83. Approximately 100 metres north of the site is a bury pit, in which clay and some gravel has been excavated. Directly west of the site, a south running creek flows, which is the sewage discharge route of the town's sewage lagoons located 2 kilometres north of the site.

The site is approximately 160 metres long and 50 metres wide. Currently two trenches are being utilized, each approximately 50 metres long, 2 metres deep and 3 metres wide. Waste is deposited in the trenches, burned, and covered with fill. One trench runs east west, the other north south, to form an L shaped configuration. Tree waste was deposited at the north side of the site. Recently signs have been posted indicating dumping areas. The site is well kept and in good condition . A wood fence separates the site area from an agricultural field. Overall site condition is good, and the nearest residence is over 400 metres away.

14.1.4 PHYSIOGRAPHY

The site area is located in the Western Upland region on the Minnedosa-Reston till plain, on the western edge of the Riding Mountains. The area features gently rolling till plains with many intermittent ponds and lakes located in low lying areas.

The major feature of the site area is the unnamed creek which runs south by the western border of the site. This creek is incised approximately 2 metres below the site level. The water level in this creek was very low during the site inspection.

Land utilization around the site is basically agricultural with few treed areas. Area and site drainage is into the adjacent creek.

14.1.5 DRILLING AND SAMPLING

A drilling and sampling program was undertaken for this site. Three groundwater monitoring wells were installed around the site area and sampled. Analytical results can be found in Appendix B, while the geologic logs are found in Appendix C.

14.2 GEOLOGIC DATA

14.2.1 GEOLOGIC SETTING

The site is located on a till plain, featuring moderately calcareous till derived mainly from shale featuring lenses of sand and gravel, with varying permeabilities. The site area is located in the region bordering a major glacial spillway located several kilometres to the west. (See Figure 14.3 and 14.4 in Appendix A).

14.2.2 BEDROCK

The bedrock underlying the site area consists of fractured shale of Cretaceous age, approximately 20 metres below grade.

14.2.3 OVERBURDEN

Approximately 20 metres of moderately calcareous glacial till overlies bedrock at this site. The upper 10 metres of this till contains several water bearing gravel lenses. The lower 10 metres is suspected to consist of low permeability clay till.

14.2.5 GEOHYDROLOGY

Two types of aquifers exist in this area. The lower aquifer consists of the fractured shale bedrock, which is protected from groundwater contamination by the till sequence. The second type of aquifers which exist in the site area are the confined sand and gravel lenses in the till. Depending on depth and location these lenses may be susceptible to contamination.

14.3 ENVIRONMENTAL INTERPRETATION AND ASSESSMENT

14.3.1 LEACHATE HYDROLOGY

The new and buried waste at this site serves as a source for leachate production. The waste is located above the saturated gravel lenses, limiting leachate migration to intermittent precipitation.

The silty clay and clayey silt underlying the site forms a 2-3 metre semipermeable confining unit. The rate of infiltration of leachates into water bearing lenses will be low.

14.3.2 METHANE

Based on the amount of waste deposited at this site, an estimated 3.5 million cubic metres of methane gas may be generated per year. Since most of the waste is burned before burial the actual suspected quantity of methane gas generated will only be a fraction of the estimate. Migration distance of any methane gas generated should be limited to approximately 30 metres, based on soil conditions.

14.3.3 WATER QUALITY

Analysis of the water samples shows little evidence of downstream groundwater contamination. Slightly higher than upstream levels of chloride and sulphate were found in the two downstream monitoring wells. All samples taken were found to be fair quality water with all parameters within the Canadian drinking water standards.

14.3.4 CONCLUSIONS

Based on the data available to date, this site poses a low environmental impact on the site area. Groundwater contamination was not detected in the monitoring wells. Some sporadic contamination caused by runoff into the creek may occur, but would be of low concern as the creek is utilized as the sewage discharge route. Overall, the site is very well run and in good condition.

14.3.5 RECOMMENDATIONS

1. A monitoring program should be implemented to sample the monitoring wells located in the site area.
2. Future trenches should be located a minimum of 10 metres from the creek.

APPENDIX A

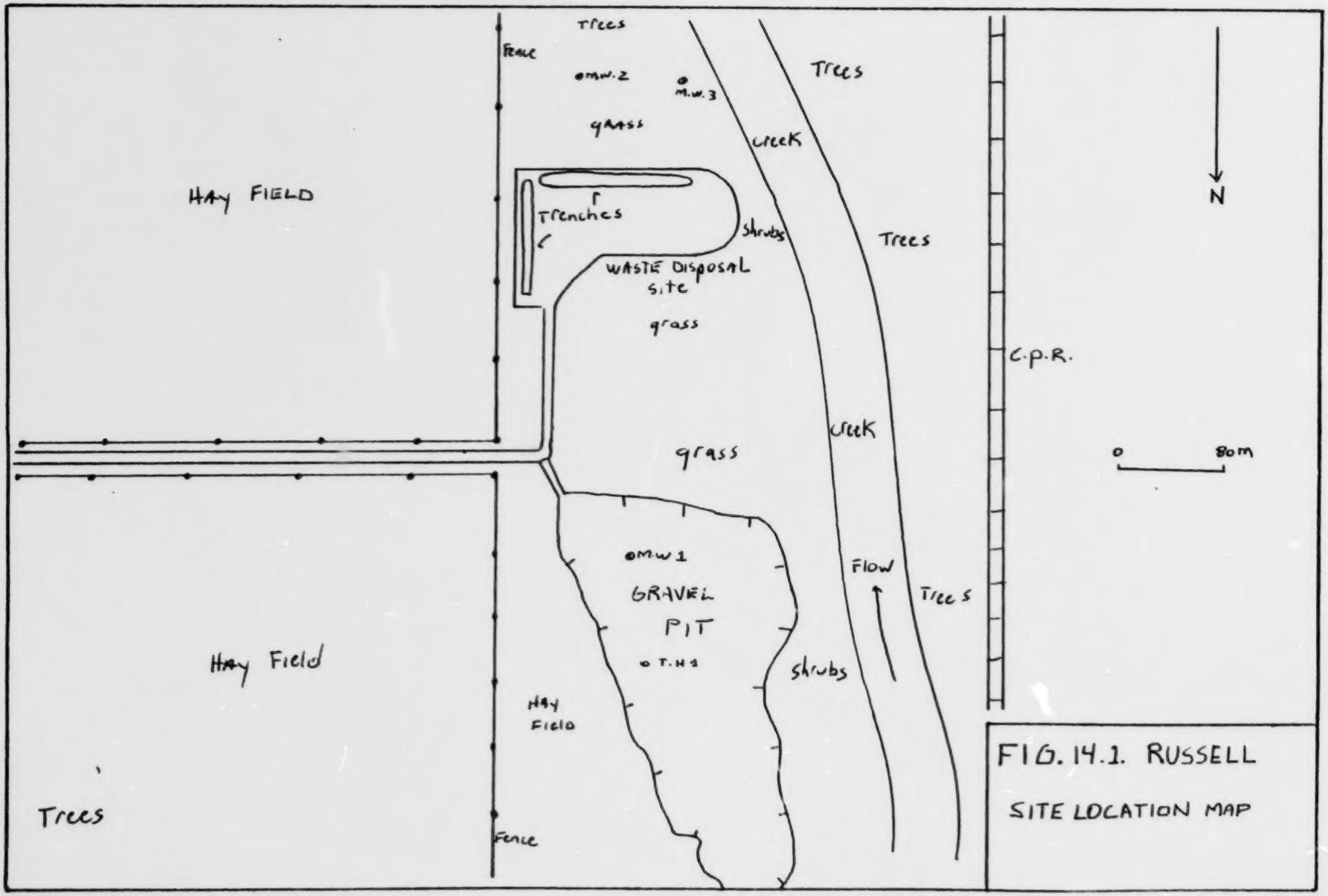

Trees
Fence
o M.W. 2
o M.W. 3
grass
Creek
Trees
HAY FIELD
Trenches
Shrubs
Trees
WASTE DISPOSAL SITE
grass
C.P.R.
N
grass
Creek
0
80m
o M.W 1
GRAVEL PIT
o T.H 1
Flow
Trees
Shrubs
Hay Field
HAY FIELD
Trees
Fence

FIG. 14.1. RUSSELL SITE LOCATION MAP

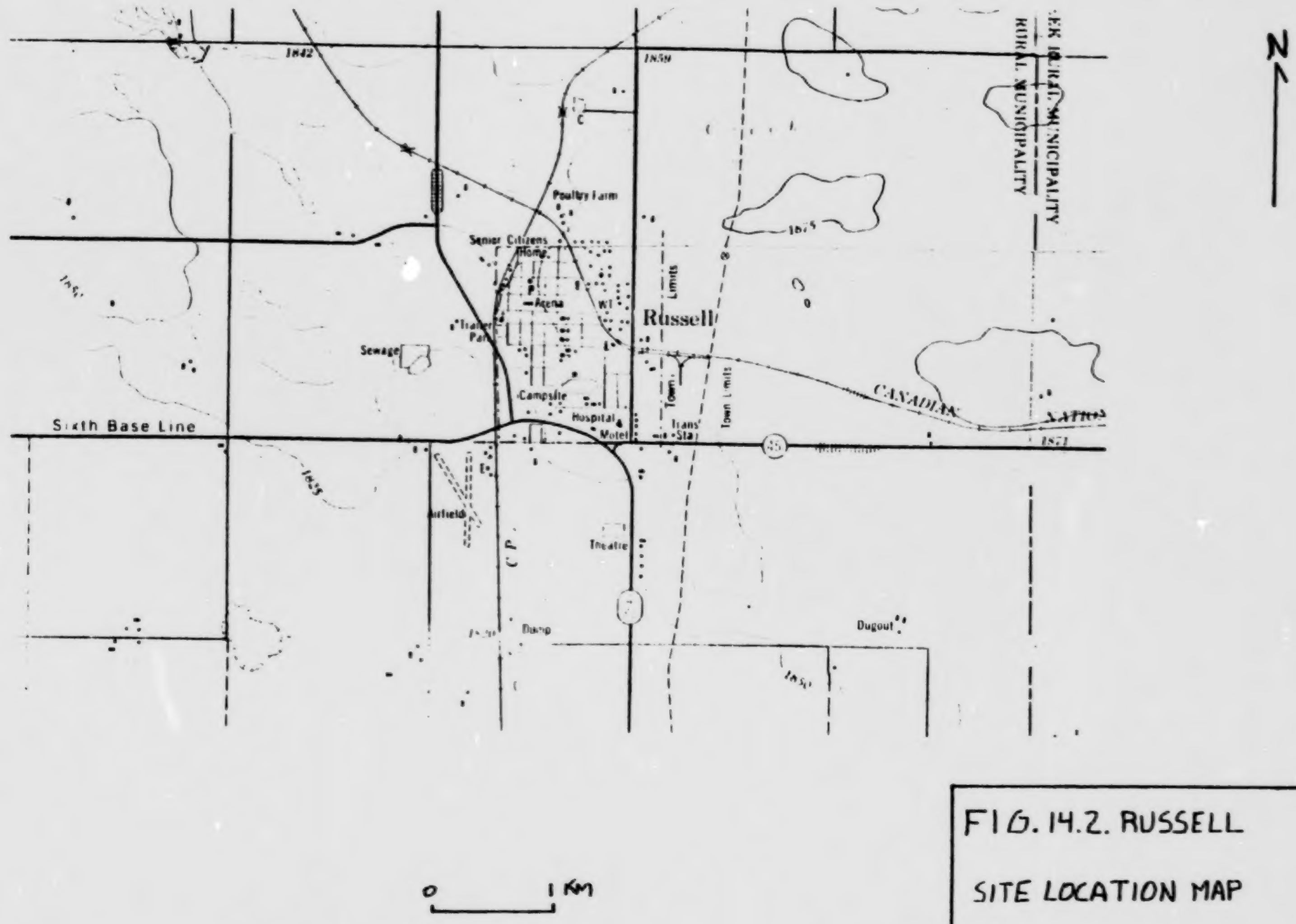

N
EK RURAL MUNICIPALITY
RURAL MUNICIPALITY
1842
1859
1875
1871
1885
1850
1825
Poultry Farm
Senior Citizens Home
Arena
WT
Russell
Trailer Park
Sewage
Campsite
Hospital
Motel
Trans Sta
Town Limits
Town Limits
CANADIAN NATIONAL
Sixth Base Line
45
C.P.
Airfield
Theatre
Dump
Dugout
0
1 KM

FIG. 14.2. RUSSELL

SITE LOCATION MAP

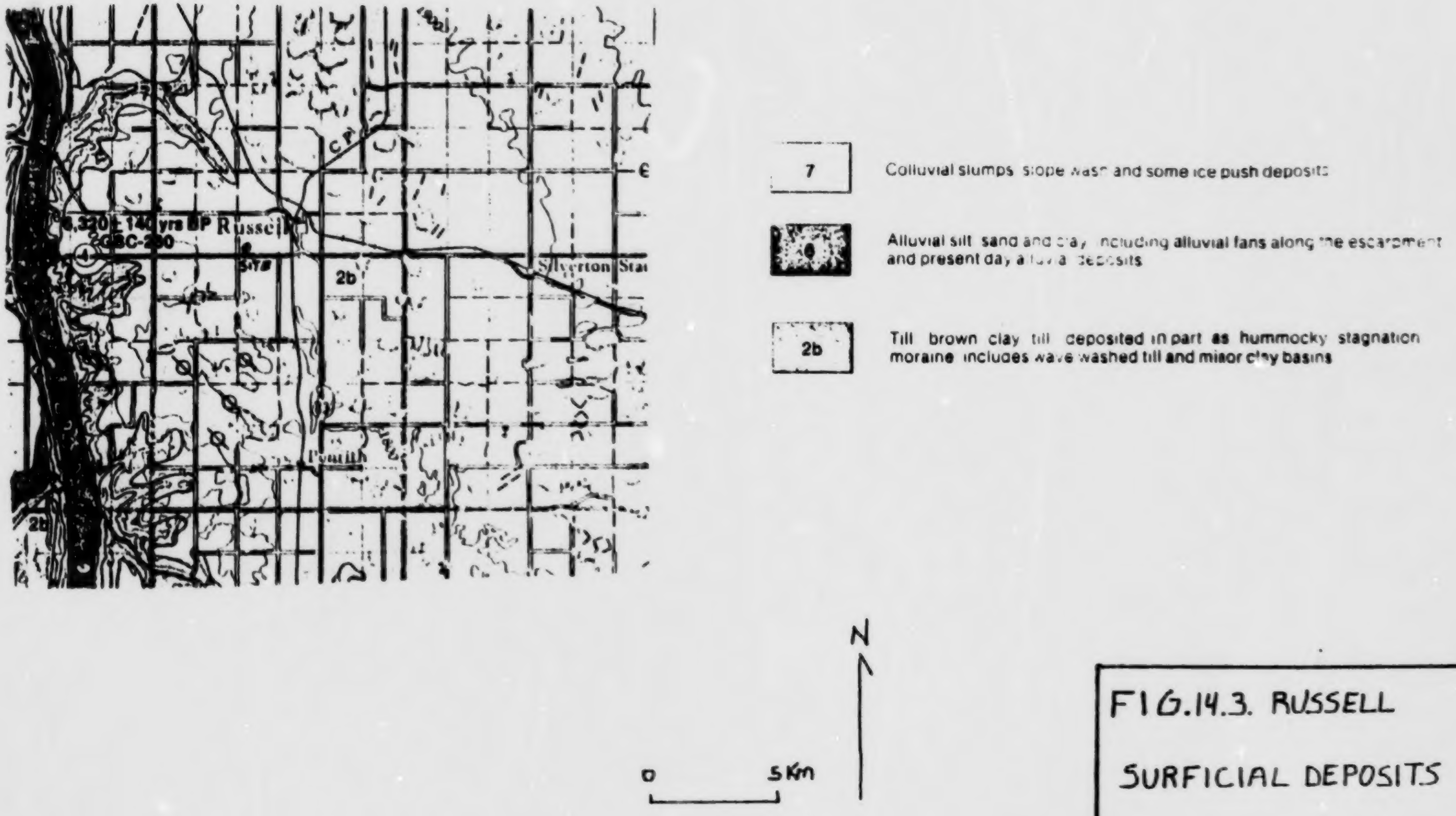

6,320 ± 140 yrs BP
Russell
SITE
CPR
2b
Silverton Sta
7
Colluvial slumps slope wash and some ice push deposits
6
Alluvial silt sand and clay including alluvial fans along the escarpment and present day alluvial deposits
2b
Till brown clay till deposited in part as hummocky stagnation moraine includes wave washed till and minor clay basins
N
0
5Km

FIG.14.3. RUSSELL
SURFICIAL DEPOSITS
MAP

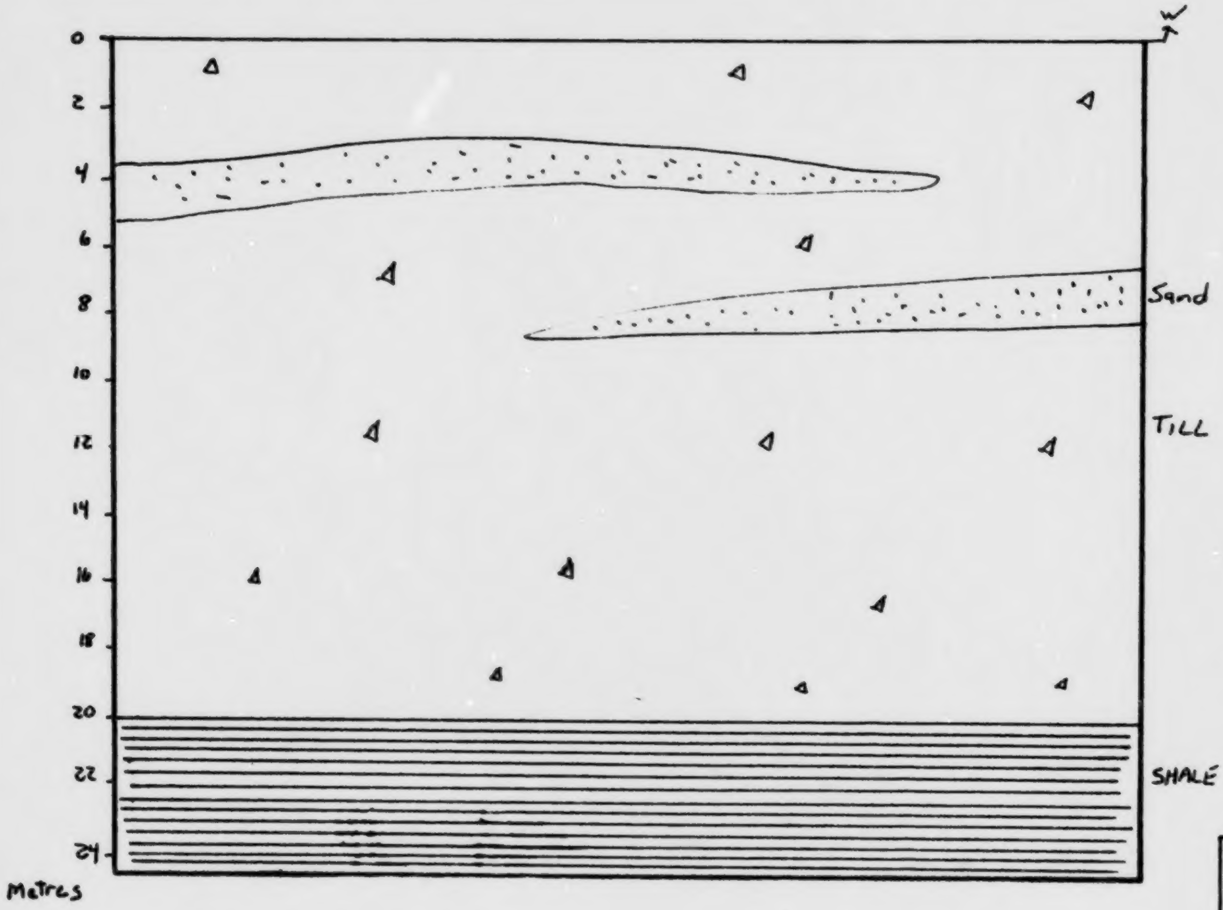

W
Sand
TILL
SHALE
0
2
4
6
8
10
12
14
16
18
20
22
24
Metres

FIG. 14.4. RUSSELL GEOLOGIC CROSS SECTION

APPENDIX B

WATER QUALITY ANALYSIS

LOCATION: Russell
SAMPLE #: Monitoring Well One
DATE: October 30, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	784	umho/cm
Residue Total	860	mg/l
Residue Filterable	530	mg/l
Residue Non Filterable	330	mg/l
pH	7.65	units
Alkalinity Total ($CaCO_3$)	336	mg/l
Alkalinity (HCO_3)	410	mg/l
Alkalinity (CO_3)	0	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	.008	mg/l
Cadmium (Ext)	.001	mg/l
Copper (Ext)	.02	mg/l
Lead (Ext)	.006	mg/l
Nickel (Ext)	.01	mg/l
Zinc (Ext)	.09	mg/l
Chromium (Ext)	.018	mg/l
Calcium (Ext)	100	mg/l
Magnesium (Ext)	40.8	mg/l
Hardness ($CaCO_3$)	438	mg/l
Manganese (Ext)	0.45	mg/l
Iron (Ext)	3.51	mg/l
Potassium (Ext)	6.50	mg/l
Sodium	26.6	mg/l
COD	22	mg/l
TOC	-	mg/l
Turbidity	200	NTU
CN (Total)	-	mg/l
Kjeldhal, Total, -N	.40	mg/l
NH_3-N. Sol.	.06	mg/l
NO_3-NO_2-N	.88	mg/l
Phosphate Total	.38	mg/l
Chloride	6	mg/l
Sulphate	98	mg/l
Coliform Group	4	per 100 ml
Fecal Coliform	0	per 100 ml

WATER QUALITY ANALYSIS

LOCATION: Russell
SAMPLE #: Monitoring Well Two
DATE: October 30, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	1860	umho/cm
Residue Total	5310	mg/l
Residue Filterable	1140	mg/l
Residue Non Filterable	4170	mg/l
pH	7.30	units
Alkalinity Total ($CaCO_3$)	498	mg/l
Alkalinity (HCO_3)	608	mg/l
Alkalinity (CO_3)	0	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	.05	mg/l
Cadmium (Ext)	.002	mg/l
Copper (Ext)	.06	mg/l
Lead (Ext)	.012	mg/l
Nickel (Ext)	.14	mg/l
Zinc (Ext)	.11	mg/l
Chromium (Ext)	.034	mg/l
Calcium (Ext)	484	mg/l
Magnesium (Ext)	150	mg/l
Hardness ($CaCO_3$)	1827	mg/l
Manganese (Ext)	.54	mg/l
Iron (Ext)	22.4	mg/l
Potassium (Ext)	9.50	mg/l
Sodium	37.6	mg/l
COD	140	mg/l
TOC	-	mg/l
Turbidity	2400	NTU
CN (Total)	-	mg/l
Kjeldhal, Total, -N	1.0	mg/l
NH_3-N. Sol.	.03	mg/l
NO_3-NO_2-N	.09	mg/l
Phosphate Total	2	mg/l
Chloride	300	mg/l
Sulphate	180	mg/l
Coliform Group	240	per 100 ml
Fecal Coliform	0	per 100 ml

WATER QUALITY ANALYSIS

LOCATION: Russell
SAMPLE #: Monitoring Well Three
DATE: October 30, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	1370	umho/cm
Residue Total	1040	mg/l
Residue Filterable	940	mg/l
Residue Non Filterable	100	mg/l
pH	7.65	units
Alkalinity Total ($CaCO_3$)	444	mg/l
Alkalinity (HCO_3)	542	mg/l
Alkalinity (CO_3)	0	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	.004	mg/l
Cadmium (Ext)	<.001	mg/l
Copper (Ext)	.01	mg/l
Lead (Ext)	<.005	mg/l
Nickel (Ext)	.014	mg/l
Zinc (Ext)	.06	mg/l
Chromium (Ext)	.007	mg/l
Calcium (Ext)	186	mg/l
Magnesium (Ext)	98.5	mg/l
Hardness ($CaCO_3$)	870	mg/l
Manganese (Ext)	1.58	mg/l
Iron (Ext)	2.21	mg/l
Potassium (Ext)	7.00	mg/l
Sodium	22.0	mg/l
COD	24	mg/l
TOC	–	mg/l
Turbidity	30	NTU
CN (Total)	–	mg/l
Kjeldhal, Total, -N	.70	mg/l
NH_3-N. Sol.	.03	mg/l
NO_3-NO_2-N	.14	mg/l
Phosphate Total	.7	mg/l
Chloride	88	mg/l
Sulphate	210	mg/l
Coliform Group	0	per 100 ml
Fecal Coliform	0	per 100 ml

APPENDIX C

GEOLOGIC LOG

LOCATION: Russell Waste Disposal Site

TEST HOLE IDENTIFICATION: M.W. 1

DATE: Oct. 26, 1985

TOTAL DEPTH: 6.36 Metres

WATER TABLE: 1.81 Metres

TYPE OF CASING: PVC 1.5 Inch Sch. 40

TYPE OF SCREEN: Polypropylene Weave

SLOTTING LENGTH: 3.36-6.36 metres

FILL MATERIAL: Silica sand, 30-40 grade

DEPTH (METRES)	DESCRIPTION
0 - .90	silty clay
.90 - 1.51	grey clay
1.51 - 1.81	clayey sand, wet
1.81 - 3.63	sandy gravel, wet
3.63 - 6.36	firm blue clay, dry.

GEOLOGIC LOG

LOCATION: Russell Waste Disposal Site

TEST HOLE IDENTIFICATION: M.W. 2

DATE: Oct. 26, 1985

TOTAL DEPTH: 7.87 Metres

WATER TABLE: 4.84 Metres

TYPE OF CASING: PVC 1.5 Inch Sch. 40

TYPE OF SCREEN: Polypropylene Weave

SLOTTING LENGTH: 4.87-7.87 metres

FILL MATERIAL: Silica sand, 30-40 grade

DEPTH (METRES)	DESCRIPTION
0 - .60	clayey topsoil
.60 - 3.30	clayey till
3.30 - 4.84	silty grey till
4.84 - 7.27	dirty sand and gravel, wet
7.27 - 7.87	dry silty clay till.

GEOLOGIC LOG

LOCATION: Russell Waste Disposal Site

TEST HOLE IDENTIFICATION: M.W. 3

DATE: Oct. 26, 1985

TOTAL DEPTH: 9.09 Metres

WATER TABLE: 3.33 Metres

TYPE OF CASING: PVC 1.5 Inch Sch. 40

TYPE OF SCREEN: Polypropylene Weave

SLOTTING LENGTH: 6-9 metres

FILL MATERIAL: Silica sand, 30-40 grade

DEPTH (METRES)	DESCRIPTION
0 - 3.03	clay till
3.03 - 8.48	coarse brown sand and gravel, wet
8.48 - 9.09	silty clay till, firm.

GEOLOGIC LOG

LOCATION: Russell Waste Disposal Site

TEST HOLE IDENTIFICATION: T.H. 1, located at the bottom of the bury pit

DATE: Oct. 25, 1985

TOTAL DEPTH: 4.54 Metres

WATER TABLE: .30 Metres

TYPE OF CASING: N/A

TYPE OF SCREEN: N/A

DEPTH (METRES)	DESCRIPTION
0 - .30	clay
.30 - .90	coarse gravel, wet
.90 - 1.8	clay till, wet
1.8 - 3.6	dirty gravel, wet
3.6 - 4.54	clay, firm, dry.

CHAPTER - FIFTEEN -

ST. CLAUDE

R.M. OF GREY

SW 17-8-7W

15 ST. CLAUDE WASTE DISPOSAL SITE

15.1 RECONNAISSANCE DATA

15.1.1 LOCATION

The Village of St. Claude is located in the R.M. of Grey, and is located approximately 35 kilometres south of Portage la Prairie along P.T.H. 2. The waste disposal site is located approximately 3 kilometres west of the Village on Section SW 17-8-7W (see Figures 15.1 and 15.2 in Appendix A).

15.1.2 BACKGROUND

The waste disposal site has been operating on this location for over 12 years. The Village of St. Claude and the R.M. of Grey jointly operate this site, which serves an estimated 1200 people. Primarily municipal waste from the Village of St. Claude and household waste from surrounding rural residents is deposited at this site. A trench system is used to dispose of garbage while a separate area for tree waste, agricultural chemical containers and bulky metallic waste is in use.

The Town water supply is derived from one well and treated before distribution. Area residents derive water from the shallow unconfined sand aquifer.

15.1.3 SITE CONDITIONS

During the site inspection on September 23, 1985, several observations were made. The site is located 3 kilometres west of the Village, south of P.T.H. 2. Access to the site is from an all weather road running 480 metres east into the site area. The site is approximately 380 metres long by 80 metres wide with an active area of approximately 80 metres by 50 metres and consists of a trench 50 metres long, 2 metres deep and 4 metres wide, with several separate areas for bulky metallic waste, agricultural chemical containers and tree waste.

Waste is deposited at the edge of the trench, burned and pushed in. The trench is full of water as the groundwater table is only 0.5 metres below grade. Agricultural chemical containers were seen in the pit along with oil and other chemical cans. Raw sewage was seen being dumped into this water filled trench. The site location and conditions are conducive to severe groundwater contamination and thus can both be considered poor. The nearest residence is located 500 metres upstream from the site. The nearest downstream residence is located 1.2 kilometres east of the site.

15.1.4 PHYSIOGRAPHY

The area is located on the lightly rolling sandflats of the Assiniboine Delta which connect the Manitoba Lowlands with the Southwestern Uplands. As the soil is very permeable, no surficial drainage ways exist, precipitation infiltrates directly into the subsurface.

Land use and vegetation consists of agricultural fields to the north and east, and tree cover to the west and south.

15.1.5 DRILLING AND SAMPLING

A drilling and sampling program was undertaken for this site. Five monitoring wells were installed around the site area and sampled. Analytical results of water samples taken can be found in Appendix B, and geologic logs in Appendix C.

15.2 GEOLOGIC DATA

15.2.1 GEOLOGIC SETTING

The site is located on an extensive surficial sand unit which is part of the proglacial Assiniboine Delta deposits. The sand is interbedded with silts and clays at depth which overly lacustrine clay and glacial till (see Figure 15.3 and 15.4 in Appendix A).

15.2.2 BEDROCK

Bedrock underlying this site, at a depth of 85 metres, consists of shale and sandstone of the Cretaceous Period.

15.2.3 OVERBURDEN

Approximately 85 metres of overburden overlies bedrock in the site area. The overburden consists of three units. The lower unit consists of glacial till, approximately 64 metres thick, and can be considered low in overall permeability. There are intermittent sand and gravel lines located in this layer. The middle unit, lacustrine clay approximately 15 metres thick is very low in permeability. The upper unit consists of Deltaic deposits 6 metres thick consisting of interbedded sand and silt. This unit forms an unconfined extensive surficial aquifer, and is highly permeable.

15.2.4 GEOHYDROLOGY

Three types of aquifers exist in the area. Water bearing fracture zones in the bedrock form aquifers confined by the impermeable till. Confined lenses of saturated sand and gravel in the till form the second type of aquifer and the third type of aquifer is the major unconfined surficial aquifer of interbedded sand and silt. Rural users derive groundwater from all three sources, however, there are no reported wells downstream of the site to the north and west, within one kilometre.

15.3 ENVIRONMENTAL INTERPRETATION AND ASSESSMENT

15.3.1 LEACHATE HYDROLOGY

The deltaic unit beneath the site forms a major aquifer and is pollution sensitive. Leachates, sewage and other chemical compounds can migrate freely into this aquifer since the waste is deposited directly below the water table.

The bedrock aquifer and confined gravel lense aquifers in the till should not be affected by leachate migration as they are protected by a thick till deposits.

15.3.2 METHANE

Based on the amount of waste deposited at this site, an estimated 4 million cubic metres of methane gas may be generated per year on this site. However, since the majority of waste is burned before burial, the actual suspected quantity of methane gas generated will only be a fraction of the above estimate. Migration distance of any methane gas produced should be limited to a distance of five to ten metres based on the soil conditions.

15.3.3 WATER QUALITY

Chemical analysis of the water samples taken from the five monitoring wells located around the waste disposal site shows evidence of contamination migrating to the northeast. Chemical parameters such as arsenic, chromium, manganese, iron, chloride and lead and bacterial levels were found to be high. Some of the above parameters were found to be above the maximum acceptable concentration standard for Canadian drinking water.

Monitoring wells located in the path of the suspected migration route are wells numbers one, four and three.

15.3.4 CONCLUSIONS

Due to the geologic conditions and operational practices, this site contaminates groundwater in the site area. It should be noted, however, that no wells are suspected to be affected as the nearest residence downstream is located 1.2 kilometres to the east. The nearest upstream residence is located 500 metres to the west. Operational procedures such as the deposition of garbage and sewage directly into a water filled trench is the cause of the local contamination; therefore, an above ground depositional system should be used and sewage should be deposited in the sewage lagoon. Relocation of the site is not feasible as the entire St. Claude area exhibits similar high water tables.

15.3.5 RECOMMENDATIONS

1. Sewage should be deposited in the St. Claude sewage lagoon.
2. Chemical containers should not be deposited in the trench.
3. An above grade depositional system should be implemented.
4. Area residential wells should be sampled.

APPENDIX A

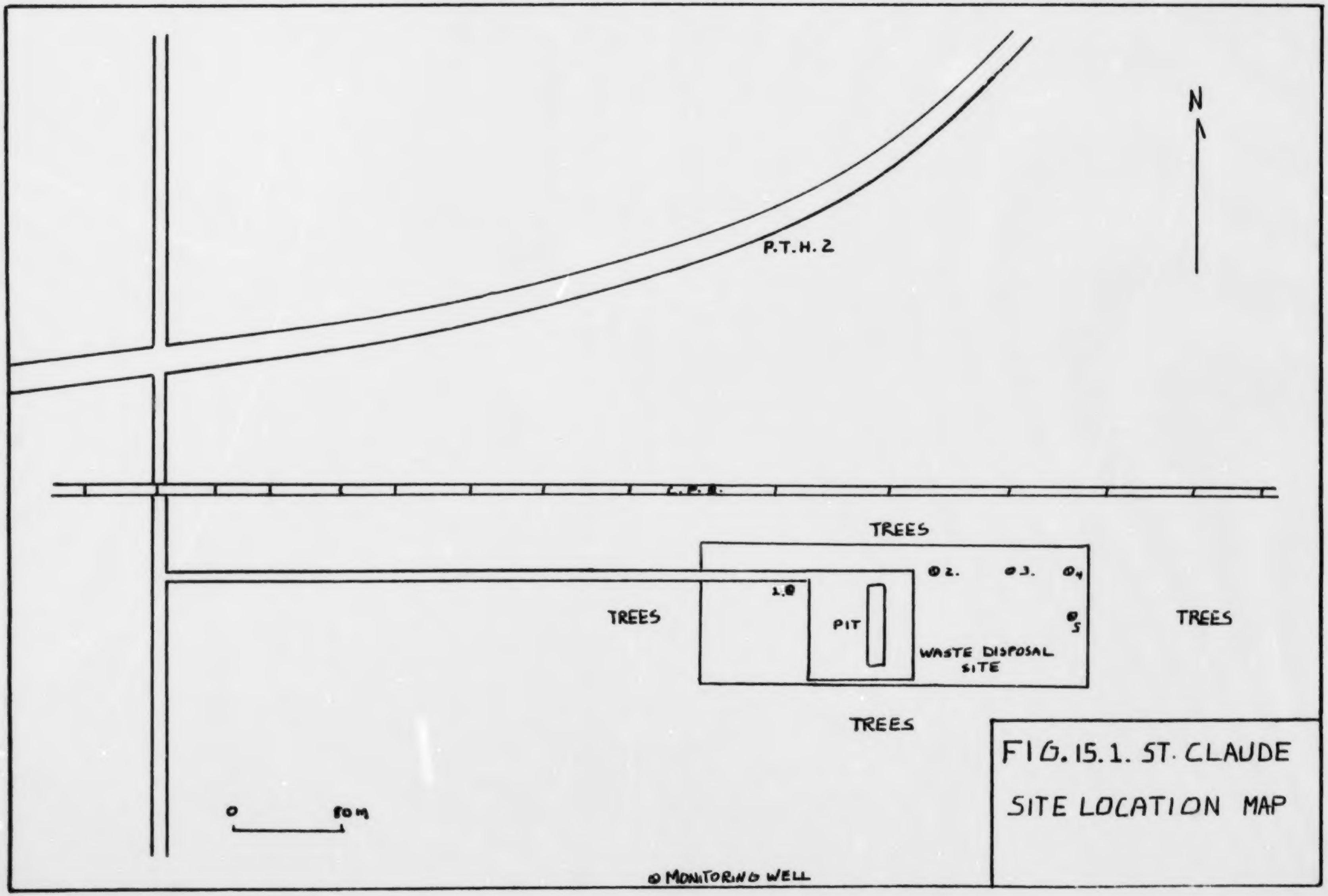

N
P.T.H. 2
C.P.R.
TREES
TREES
TREES
TREES
1.
2.
3.
4
5
PIT
WASTE DISPOSAL SITE
0
80 m
MONITORING WELL

FIG. 15.1. ST. CLAUDE SITE LOCATION MAP

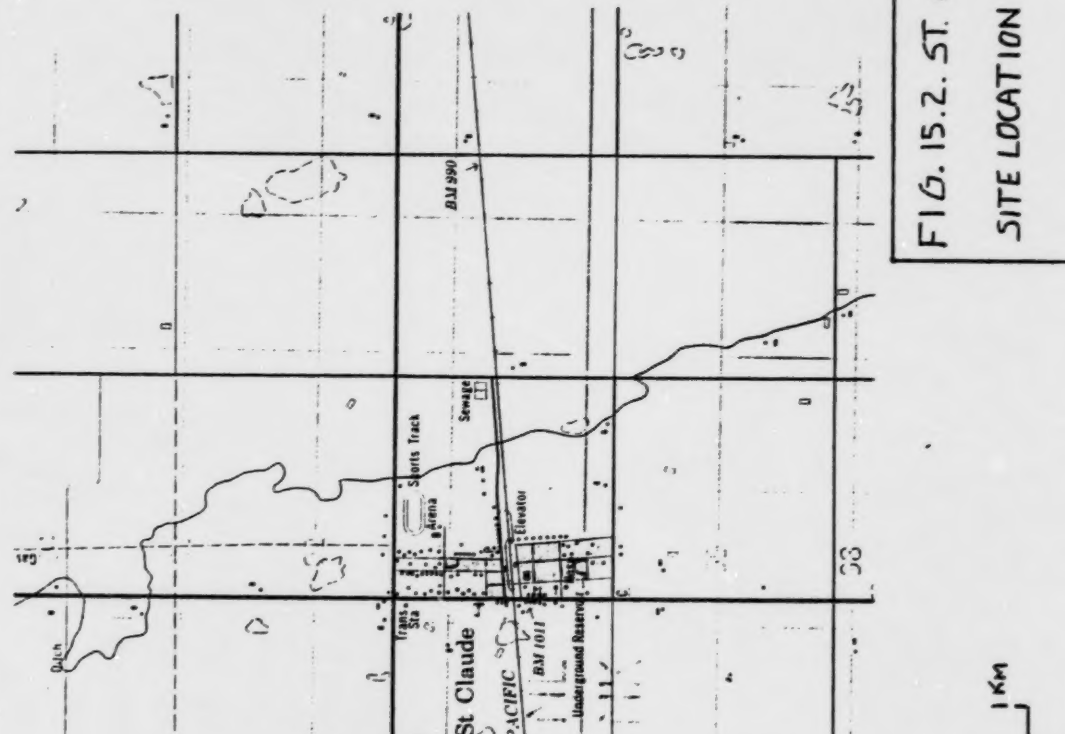

St Claude
CANADIAN
PACIFIC
BM 990
BM 1011
BM 1040
Sewage
Sports Track
Arena
Elevator
Trans. Sta
Underground Reservoir
Dump
Ditch
Poultry Farm
SOUTH NORFOLK RURAL MUNICIPALITY
GREY RURAL MUNICIPALITY
0
1KM
N

FIG. 15.2. ST. CLAUDE SITE LOCATION MAP

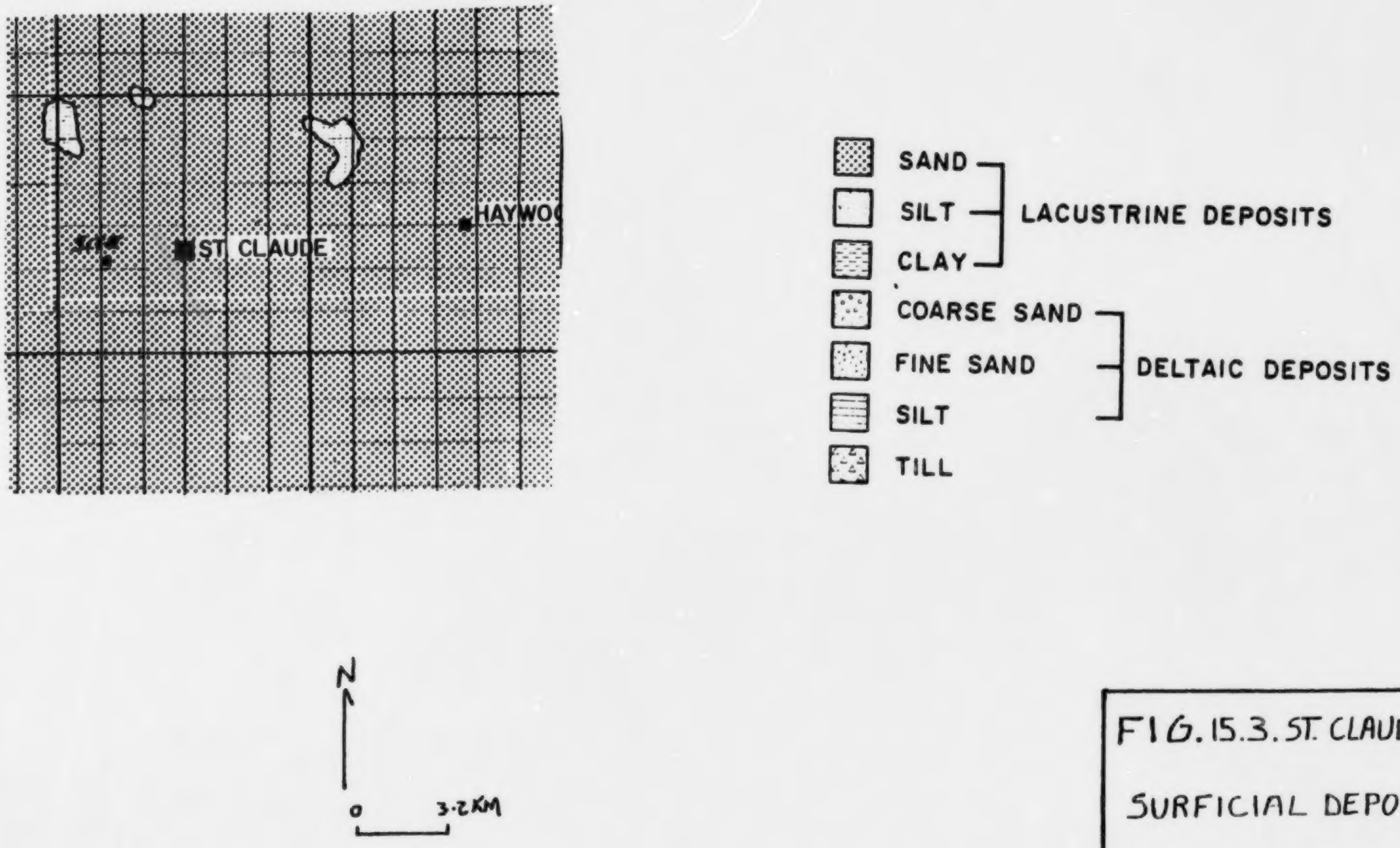

HAYWOO
ST. CLAUDE
SAND
SILT
CLAY
LACUSTRINE DEPOSITS
COARSE SAND
FINE SAND
SILT
DELTAIC DEPOSITS
TILL
N
0
3·2KM

FIG.15.3. ST. CLAUDE
SURFICIAL DEPOSITS
MAP

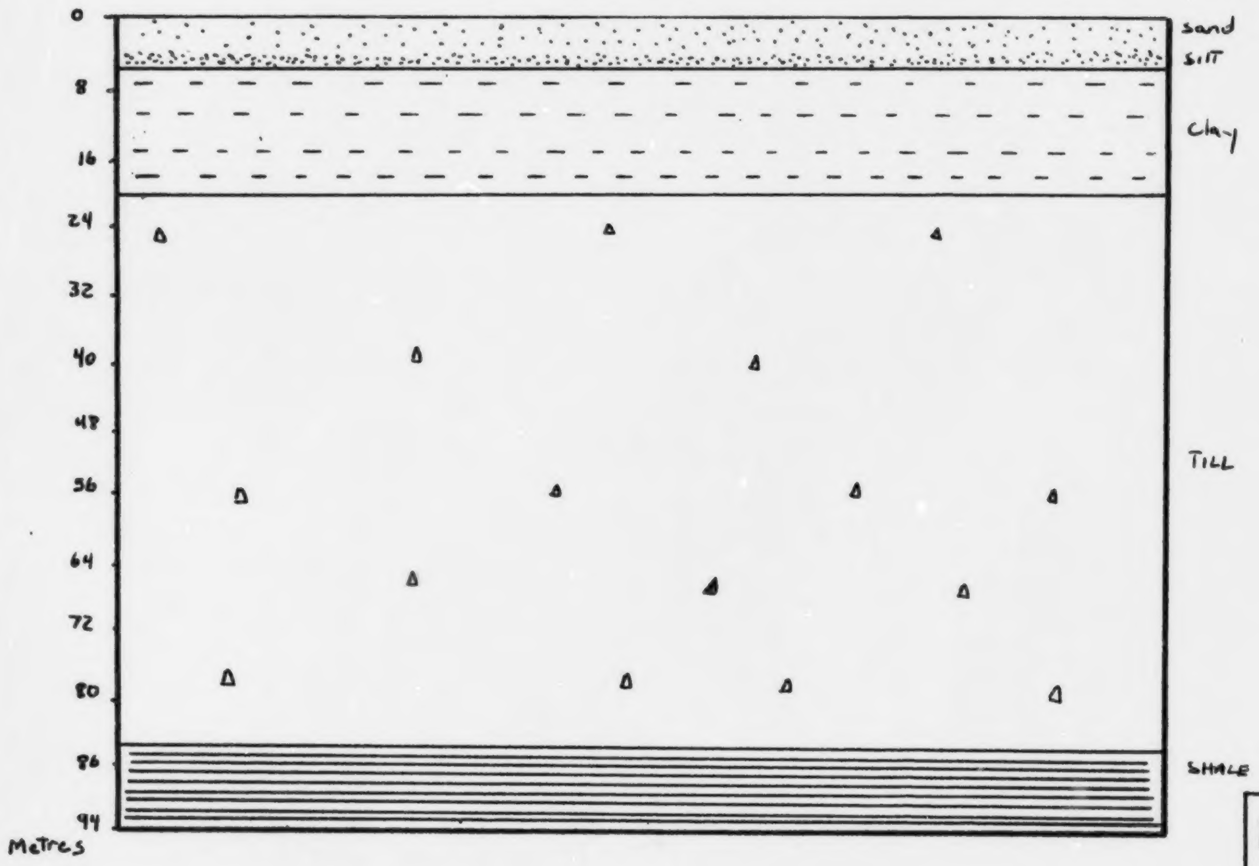

0
8
16
24
32
40
48
56
64
72
80
86
94
Metres
sand
silt
Clay
TILL
SHALE

FIG. 15.4. ST. CLAUDE GEOLOGIC CROSS SECTION

APPENDIX B

WATER QUALITY ANALYSIS

LOCATION: St. Claude

SAMPLE #: Monitoring Well One

DATE: October 30, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	3160	umho/cm
Residue Total	17300	mg/l
Residue Filterable	5300	mg/l
Residue Non Filterable	12000	mg/l
pH	6.95	units
Alkalinity Total ($CaCO_3$)	1056	mg/l
Alkalinity (HCO_3)	1288	mg/l
Alkalinity (CO_3)	0	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	.15	mg/l
Cadmium (Ext)	<.001	mg/l
Copper (Ext)	.02	mg/l
Lead (Ext)	<.005	mg/l
Nickel (Ext)	.046	mg/l
Zinc (Ext)	.08	mg/l
Chromium (Ext)	.17	mg/l
Calcium (Ext)	706	mg/l
Magnesium (Ext)	116	mg/l
Hardness ($CaCO_3$)	2240	mg/l
Manganese (Ext)	5.91	mg/l
Iron (Ext)	54.4	mg/l
Potassium (Ext)	14.5	mg/l
Sodium	324	mg/l
COD	780	mg/l
TOC	-	mg/l
Turbidity	1500	NTU
CN (Total)	<.02	mg/l
Kjeldhal, Total, -N	11.0	mg/l
NH_3-N. Sol.	6.0	mg/l
NO_3-NO_2-N	<.01	mg/l
Phosphate Total	2.1	mg/l
Chloride	520	mg/l
Sulphate	13.2	mg/l
Coliform Group	20	per 100 ml
Fecal Coliform	0	per 100 ml

WATER QUALITY ANALYSIS

LOCATION: St. Claude
SAMPLE #: Monitoring Well Two
DATE: October 30, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	974	umho/cm
Residue Total	900	mg/l
Residue Filterable	570	mg/l
Residue Non Filterable	330	mg/l
pH	7.25	units
Alkalinity Total ($CaCO_3$)	538	mg/l
Alkalinity (HCO_3)	656.	mg/l
Alkalinity (CO_3)	0	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	.014	mg/l
Cadmium (Ext)	<.001	mg/l
Copper (Ext)	.02	mg/l
Lead (Ext)	.011	mg/l
Nickel (Ext)	.016	mg/l
Zinc (Ext)	.06	mg/l
Chromium (Ext)	.009	mg/l
Calcium (Ext)	145	mg/l
Magnesium (Ext)	59.6	mg/l
Hardness ($CaCO_3$)	394	mg/l
Manganese (Ext)	1.53	mg/l
Iron (Ext)	5.14	mg/l
Potassium (Ext)	6.00	mg/l
Sodium	27.5	mg/l
COD	190	mg/l
TOC	-	mg/l
Turbidity	75.	NTU
CN (Total)	<.02	mg/l
Kjeldhal, Total, -N	1.2	mg/l
NH_3-N. Sol.	.35	mg/l
NO_3-NO_2-N	.13	mg/l
Phosphate Total	.26	mg/l
Chloride	8.0	mg/l
Sulphate	43	mg/l
Coliform Group	23	per 100 ml
Fecal Coliform	0	per 100 ml

WATER QUALITY ANALYSIS

LOCATION: St. Claude
SAMPLE #: Monitoring Well Three
DATE: October 30, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	942	umho/cm
Residue Total	1820	mg/l
Residue Filterable	580	mg/l
Residue Non Filterable	1240	mg/l
pH	7.20	units
Alkalinity Total ($CaCO_3$)	528.	mg/l
Alkalinity (HCO_3)	644	mg/l
Alkalinity (CO_3)	0	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	.025	mg/l
Cadmium (Ext)	.001	mg/l
Copper (Ext)	.04	mg/l
Lead (Ext)	.017	mg/l
Nickel (Ext)	.040	mg/l
Zinc (Ext)	.13	mg/l
Chromium (Ext)	.039	mg/l
Calcium (Ext)	171.	mg/l
Magnesium (Ext)	70.5	mg/l
Hardness ($CaCO_3$)	718.	mg/l
Manganese (Ext)	1.35	mg/l
Iron (Ext)	9.57	mg/l
Potassium (Ext)	7.50	mg/l
Sodium	27.5	mg/l
COD	310	mg/l
TOC	-	mg/l
Turbidity	375	NTU
CN (Total)	<.02	mg/l
Kjeldhal, Total, -N	3.0	mg/l
NH_3-N. Sol.	.28	mg/l
NO_3-NO_2-N	.15	mg/l
Phosphate Total	2.4	mg/l
Chloride	7.0	mg/l
Sulphate	43	mg/l
Coliform Group	1500+	per 100 ml
Fecal Coliform	0	per 100 ml

WATER QUALITY ANALYSIS

LOCATION: St. Claude
SAMPLE #: Monitoring Well Four
DATE: October 30, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	933	umho/cm
Residue Total	40400	mg/l
Residue Filterable	2400	mg/l
Residue Non Filterable	38000	mg/l
pH	7.50	units
Alkalinity Total ($CaCO_3$)	1082	mg/l
Alkalinity (HCO_3)	1320	mg/l
Alkalinity (CO_3)	0	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	.49	mg/l
Cadmium (Ext)	.002	mg/l
Copper (Ext)	.02	mg/l
Lead (Ext)	<.005	mg/l
Nickel (Ext)	.02	mg/l
Zinc (Ext)	<.01	mg/l
Chromium (Ext)	.37	mg/l
Calcium (Ext)	1085	mg/l
Magnesium (Ext)	83.3	mg/l
Hardness ($CaCO_3$)	3055	mg/l
Manganese (Ext)	5.83	mg/l
Iron (Ext)	.12	mg/l
Potassium (Ext)	8.00	mg/l
Sodium	41.7	mg/l
COD	940	mg/l
TOC	-	mg/l
Turbidity	6000	NTU
CN (Total)	<.02	mg/l
Kjeldhal, Total, -N	15.0	mg/l
NH_3-N. Sol.	.19	mg/l
NO_3-NO_2-N	.59	mg/l
Phosphate Total	.06	mg/l
Chloride	8.0	mg/l
Sulphate	78	mg/l
Coliform Group	1900+	per 100 ml
Fecal Coliform	0	per 100 ml

WATER QUALITY ANALYSIS

LOCATION: St. Claude
SAMPLE #: Monitoring Well Five
DATE: September 9, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	1050	umho/cm
Residue Total	1020	mg/l
Residue Filterable	620	mg/l
Residue Non Filterable	400	mg/l
pH	7.45	units
Alkalinity Total ($CaCO_3$)	526.	mg/l
Alkalinity (HCO_3)	642.	mg/l
Alkalinity (CO_3)	0	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	.015	mg/l
Cadmium (Ext)	.001	mg/l
Copper (Ext)	<.01	mg/l
Lead (Ext)	<.005	mg/l
Nickel (Ext)	<.005	mg/l
Zinc (Ext)	.01	mg/l
Chromium (Ext)	.011	mg/l
Calcium (Ext)	136	mg/l
Magnesium (Ext)	58.5	mg/l
Hardness ($CaCO_3$)	581	mg/l
Manganese (Ext)	.98	mg/l
Iron (Ext)	1.61	mg/l
Potassium (Ext)	5.50	mg/l
Sodium	15.5	mg/l
COD	75	mg/l
TOC	–	mg/l
Turbidity	200	NTU
CN (Total)	<.02	mg/l
Kjeldhal, Total, -N	1.0	mg/l
NH_3-N. Sol.	.16	mg/l
NO_3-NO_2-N	.03	mg/l
Phosphate Total	.35	mg/l
Chloride	13	mg/l
Sulphate	40	mg/l
Coliform Group	93	per 100 ml
Fecal Coliform	0	per 100 ml

APPENDIX C

GEOLOGIC LOG

LOCATION: St. Claude Waste Disposal Site

TEST HOLE IDENTIFICATION: M.W. 1

DATE: Oct. 23, 1985

TOTAL DEPTH: 9.09 Metres

WATER TABLE: .60 Metres

TYPE OF CASING: PVC 1.5 Inch Sch. 40

TYPE OF SCREEN: Polypropylene Weave

SLOTTING LENGTH: 6-9 metres

FILL MATERIAL: Silica sand, 30-40 grade

DEPTH (METRES)	DESCRIPTION
0 - .30	clayey topsoil
.30 - 1.5	silty sand, grey, wet
1.5 - 3.3	S.A.A. but coarser, wet
3.3 - 4.5	clayey silt, wet
4.5 - 7.6	S.A.A., higher clay content, wet
7.6 - 9.9	silty clay, dry

GEOLOGIC LOG

LOCATION: St. Claude Waste Disposal Site

TEST HOLE IDENTIFICATION: M.W. 2

DATE: Oct. 23, 1985

TOTAL DEPTH: 7.5 Metres

WATER TABLE: .90 Metres

TYPE OF CASING: PVC 1.5 Inch Sch. 40

TYPE OF SCREEN: Polypropylene Weave

SLOTTING LENGTH: 4.5-7.5 metres

FILL MATERIAL: Silica sand, 30-40 grade

DEPTH (METRES)	DESCRIPTION
0 - .60	fine brown sandy topsoil
.60 - 1.2	sand, brown, fine to med.
1.2 - 1.8	sand with some clay
1.8 - 2.7	silty sand, brown
2.7 - 3.0	S.A.A., but grey
3.0 - 3.9	silty sand, with some clay
3.9 - 4.5	S.A.A., increasing clay
4.5 - 6.0	grey silty clay
6.0 - 7.5	firm plastic clay, dry.

GEOLOGIC LOG

LOCATION: St. Claude Waste Disposal Site

TEST HOLE IDENTIFICATION: M.W. 3

DATE: Oct. 23, 1985

TOTAL DEPTH: 7.8 Metres

WATER TABLE: 1.2 Metres

TYPE OF CASING: PVC 1.5 Inch Sch. 40

TYPE OF SCREEN: Polypropylene Weave

SLOTTING LENGTH: 4.8-7.8 metres

FILL MATERIAL: Silica sand, 30-40 grade

DEPTH (METRES)	DESCRIPTION
0 - 1.5	sand, med., brown topsoil
1.5 - 2.4	silty sand
2.4 - 3.0	S.A.A., with some clay
3.0 - 4.2	clayey silt with sand
4.2 - 6.0	S.A.A., higher clay content
6.0 - 6.4	silty sand
6.4 - 7.8	solid clay firm

GEOLOGIC LOG

LOCATION: St. Claude Waste Disposal Site

TEST HOLE IDENTIFICATION: M.W. 4

DATE: Oct. 23, 1985

TOTAL DEPTH: 6.4 Metres

WATER TABLE: 1.06 Metres

TYPE OF CASING: PVC 1.5 Inch Sch. 40

TYPE OF SCREEN: Polypropylene Weave

SLOTTING LENGTH: 3.4-6.4 metres

FILL MATERIAL: Silica sand, 30-40 grade

DEPTH (METRES)	DESCRIPTION
0 - .60	med. brown sandy topsoil
.60 - 1.36	clayey silt brown
1.36 - 1.51	silty sandy
1.51 - 2.72	clayey silt brown
2.72 - 3.03	S.A.A., but grey
3.03 - 3.94	silty sand
3.94 - 4.54	fine sand, grey, clean
4.54 - 6.4	clayey silt
6.4 - 6.9	clay, firm.

GEOLOGIC LOG

LOCATION: St. Claude Waste Disposal Site

TEST HOLE IDENTIFICATION: M.W. 5

DATE: July 17, 1985

TOTAL DEPTH: 3.9 Metres

WATER TABLE: 1.5 Metres

TYPE OF CASING: PVC 1.5 Inch Sch. 40

TYPE OF SCREEN: Polypropylene Weave

SLOTTING LENGTH: 0.9-3.9 metres

FILL MATERIAL: Silica sand, 30-40 grade

DEPTH (METRES)	DESCRIPTION
0 - .30	clayey topsoil
.30 - 2.0	silty sand, grey
2.0 - 3.7	S.A.A. but coarser
3.7 - 3.9	clayey silt

CHAPTER - SIXTEEN -

TEULON

R.M. OF ROCKWOOD

SW 30-16-2E

16 TEULON WASTE DISPOSAL SITE

16.1 RECONNAISSANCE DATA

16.1.1 LOCATION

The Village of Teulon is located in the R.M. of Rockwood approximately 45 kilometres north of Winnipeg along P.T.H. 7. The waste disposal site is located approximately 3 kilometres west of town (see Figures 16.1 and 16.2 in Appendix A).

16.1.2 BACKGROUND

This waste disposal site has been operating in its present location for over 34 years. In April 1978, the site was registered with the Province as an existing waste disposal grounds. Current records show that this site serves a population of approximately 2250 people. Primarily municipal waste from the Town of Teulon and household waste from surrounding rural residents is deposited at this site. A trench system is used to dispose of garbage, while bulky metallic and construction wastes are collected on the surface. Rural and town water supplies are privately owned wells set into the bedrock aquifer.

16.1.3 SITE CONDITIONS

During the site inspection on September 16, 1985, several observations were made. The site is located off a section road running east-west which originates at a junction with P.T.H. 7. The site is located 175 metres north of this section road, with an active area of approximately 150 metres by 80 metres. The active area is made up of two major sections. In the west part of the site a trench 40 metres long, 3 metres wide and 3 metres deep is used to dispose of solid waste, while construction and bulky metallic waste are deposited on the east side of the site and forms a dumping terrace 2 metres above grade and 100 metres long. On this dumping terrace agricultural chemical containers are collected, however, some agricultural chemical containers can be seen littered throughout the site.

Currently the dumping terrace is encroaching onto two dugouts. Strewn waste can be found throughout the site, and no fences are in place to designate the active area. The site location is good as the nearest residence is over 400 metres away, however, site condition can be improved, with upgraded organization.

16.1.4 PHYSIOGRAPHY

This waste disposal site is situated in the Manitoba lowlands, on the Red River plain, on the prairie level which connects Lake Manitoba and Lake Winnipeg.

The immediate site area shows little to no relief. Surficial gravel deposits in the till in the area form intermittent ponds where the topography dips below the water table. The site itself is located adjacent to a gravel pit, with several ponds in the area. Drainage on the site is into ditches which run parallel to the section road, which eventually drains into Ross Creek. The site area is basically forested with little agricultural land in the immediate vicinity.

16.1.5 DRILLING AND SAMPLING

A drilling program was undertaken on site to confirm geologic conditions, while three samples were taken from area ponds to test for surface water contamination (see Appendix B for water analytical results and Appendix C for geologic logs).

16.2 GEOLOGIC DATA

16.2.1 GEOLOGIC SETTING

The area is located in the relatively flat Manitoba lowlands of the interlake region consisting of highly calcareous glacial till overlying lacustrine sediments, which in turn overlies limestone bedrock. Surficial gravel deposits are found intermittently throughout the area. (See Figure 16.3 and 16.4 in Appendix A).

16.2.2 BEDROCK

At a depth of 20 metres limestone and dolomite of the Ordovician period is found.

16.2.3 OVERBURDEN

Approximately 20 metres of highly calcareous till with minor sand and gravel lenses, overlie limestone bedrock.

16.2.4 GEOHYDROLOGY

At depth the fractured limestone bedrock forms a major confined aquifer in this region. Minor confined gravel and sand aquifers in the till may exist, while an unconfined gravel aquifer is located west of the site. Groundwater flow in this region is east toward Lake Winnipeg. The majority of precipitation is absorbed and transpired in the moderately impermeable soil in the site area, with excess running off into drainage ditches located south of the site, and into several dugouts on the site.

16.3 ENVIRONMENTAL INTERPRETATION AND ASSESSMENT

16.3.1 LEACHATE HYDROLOGY

Leachate on this site is generated by precipitation infiltrating the buried waste. Due to the low permeability of the underlying till, the migration of leachate is not likely to enter the subsurface beyond a few metres in depth. Consequently, the possibility of groundwater contamination of the bedrock aquifer is low.

Runoff from the site may allow sporadic contamination of the drainage ditches located to the south of the site. As drainage is to the south and east towards Lake Winnipeg, the surficial aquifer located west of the site is not suspected to be affected by the site operation.

16.3.2 METHANE

Based on the amount of waste deposited at this site an estimated 9 million cubic metres of methane gas may be generated per year. Since the majority of waste is burned before fill covering, the actual suspected quantity of methane gas generated will only be a fraction of the estimate. Migration distance of any methane gas generated should be limited to approximately 30 metres, based on soil conditions.

16.3.3 WATER QUALITY

Water quality analysis of the three surface water samples taken indicates no evidence of surface water contamination by site runoff. The three water samples all show low concentrations of ions and dissolved solids.

16.3.4 CONCLUSION

Based on the available data, the environmental impact of this site is low. The site has no apparent effect on the bedrock aquifer because of the clayey till overburden. Further it appears the site has no apparent effect on the nearby surficial aquifer because of the overburden and drainage characteristics of the site area. The general condition of the site poses some problems, as waste was seen strewn throughout the site, and some waste disposal areas are encroaching dugouts.

16.3.5 RECOMMENDATIONS

1. Ponds on the site should be filled in.
2. Strewn waste should be collected and buried.
3 Fences should be erected around the active area.
4. Signs should indicate the pesticide chemical container disposal pile.

APPENDIX A

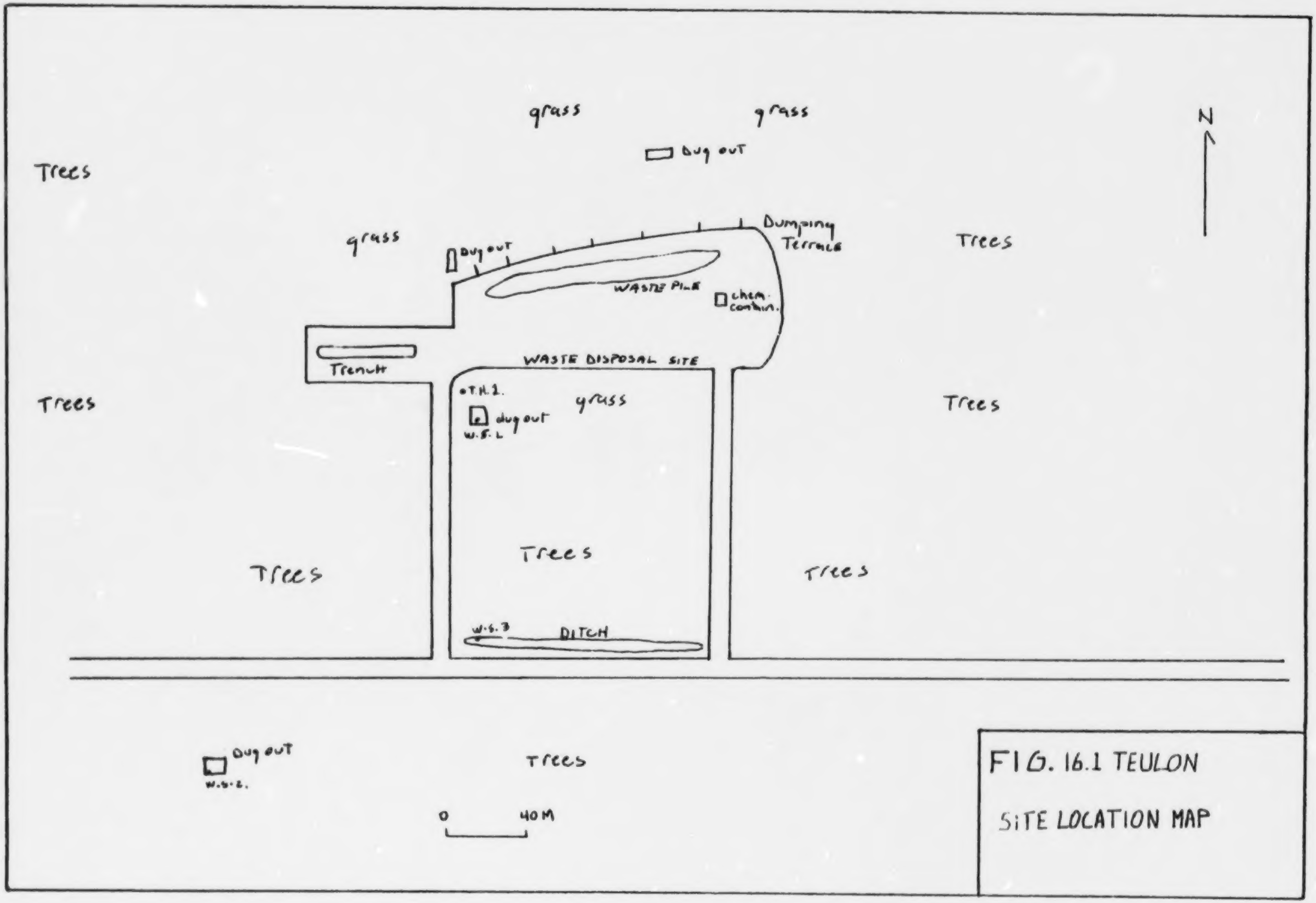

N
grass
grass
Dug out
Trees
grass
Dug out
Dumping Terrace
Trees
WASTE PILE
chem. contain.
Trench
WASTE DISPOSAL SITE
•T.H.1.
grass
dug out
W.S.1.
Trees
Trees
Trees
Trees
W.S.3
DITCH
Trees
Dug out
W.S.2.
Trees
0
40M

FIG. 16.1 TEULON
SITE LOCATION MAP

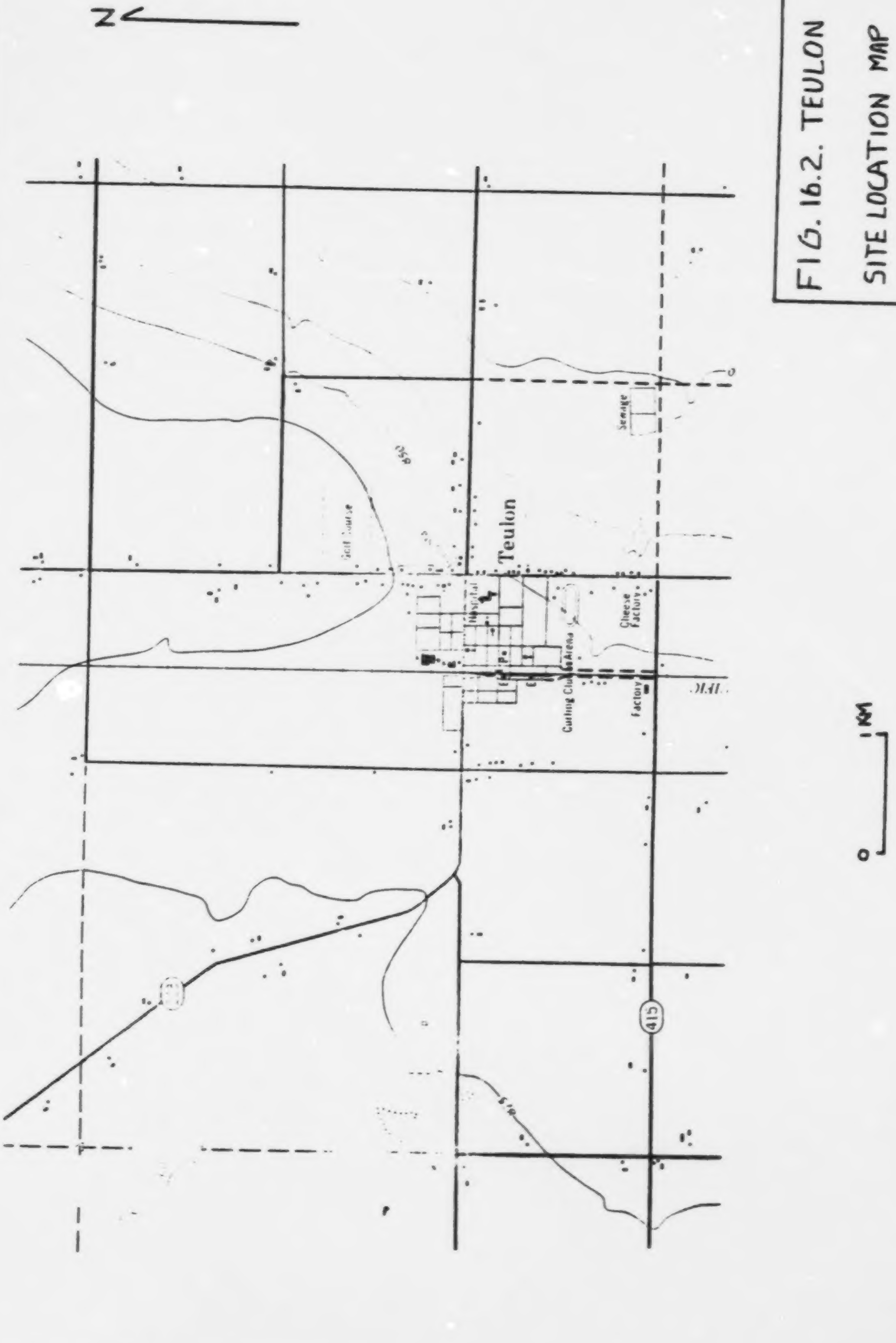

N
Teulon
Golf Course
Hospital
Arena
Curling Club
Cheese Factory
Factory
Sewage
415
0
1 KM

FIG. 16.2. TEULON SITE LOCATION MAP

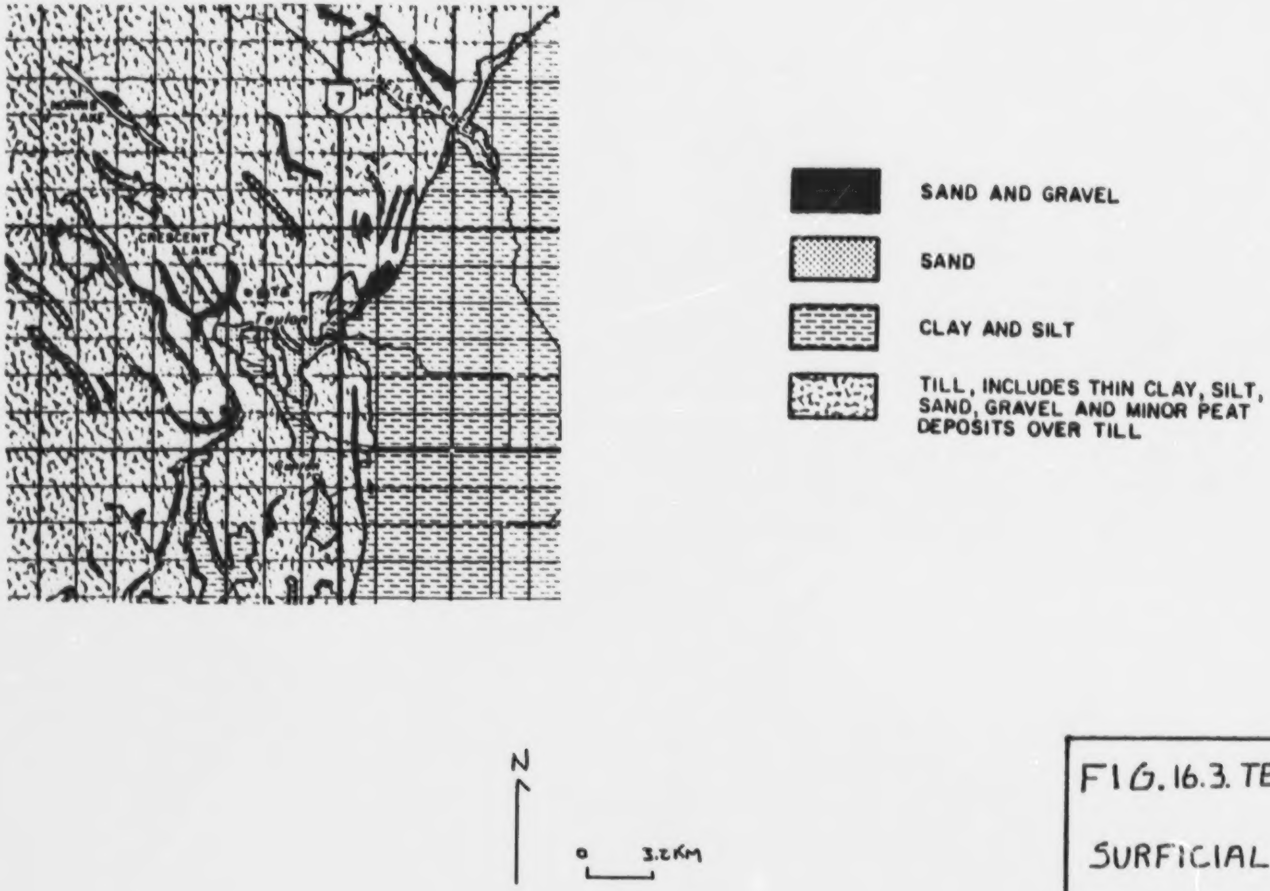

CRESCENT LAKE
Teulon
7
SAND AND GRAVEL
SAND
CLAY AND SILT
TILL, INCLUDES THIN CLAY, SILT, SAND, GRAVEL AND MINOR PEAT DEPOSITS OVER TILL
N
0
3.2KM

FIG. 16.3. TEULON

SURFICIAL DEPOSITS

MAP

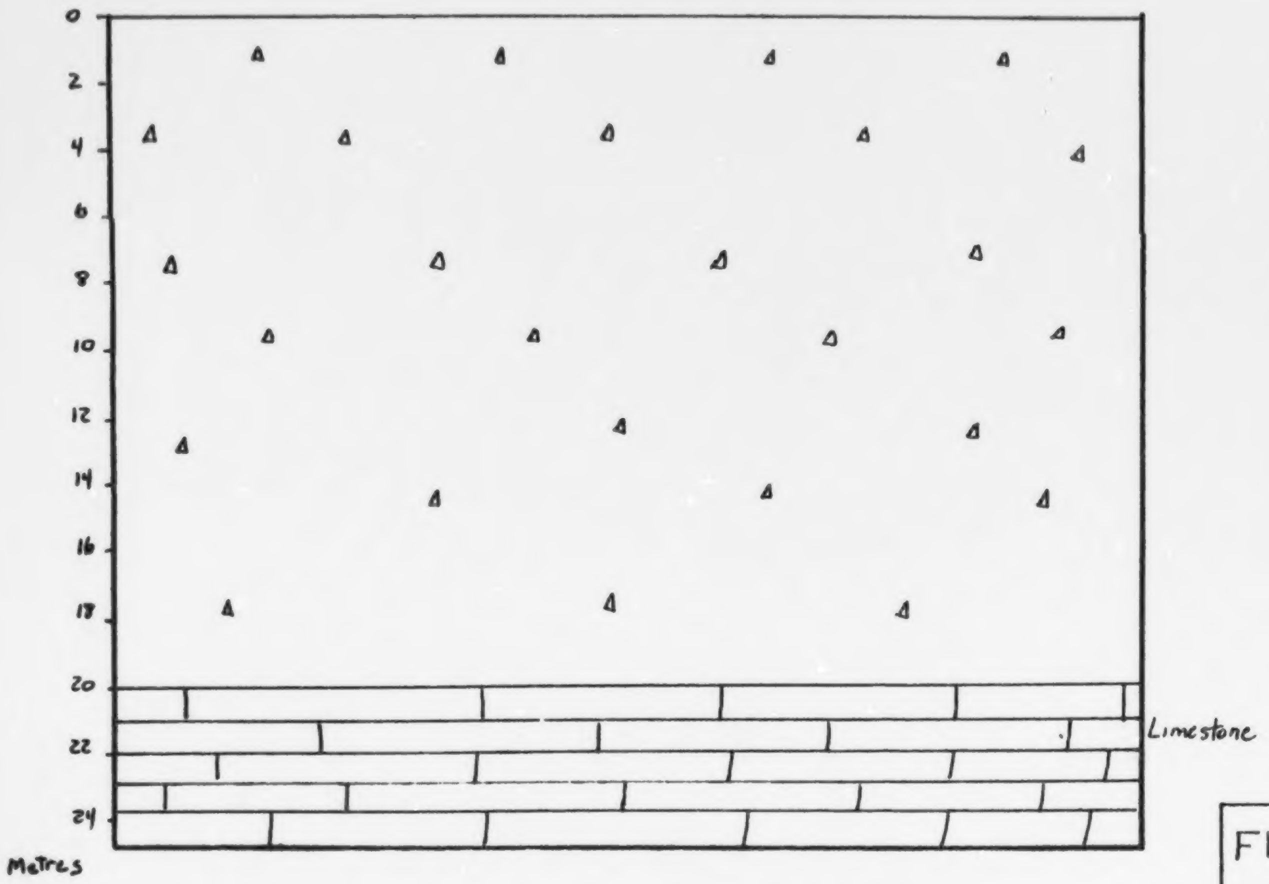

0
2
4
6
8
10
12
14
16
18
20
22
24
Metres
Limestone

FIG.16.4. TEULON GEOLOGIC CROSS SECTION

APPENDIX B

WATER QUALITY ANALYSIS

LOCATION: Teulon
SAMPLE #: Dugout One
DATE: September 16, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	337	umho/cm
Residue Total	220	mg/l
Residue Filterable	220	mg/l
Residue Non Filterable	<5	mg/l
pH	8.90	units
Alkalinity Total ($CaCO_3$)	178	mg/l
Alkalinity (HCO_3)	188	mg/l
Alkalinity (CO_3)	14.4	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	.002	mg/l
Cadmium (Ext)	<.001	mg/l
Copper (Ext)	<.01	mg/l
Lead (Ext)	<.005	mg/l
Nickel (Ext)	<.005	mg/l
Zinc (Ext)	<.01	mg/l
Chromium (Ext)	<.005	mg/l
Calcium (Ext)	17.0	mg/l
Magnesium (Ext)	33.8	mg/l
Hardness ($CaCO_3$)	182	mg/l
Manganese (Ext)	<.02	mg/l
Iron (Ext)	.06	mg/l
Potassium (Ext)	<5.00	mg/l
Sodium	3.5	mg/l
COD	37	mg/l
TOC	-	mg/l
Turbidity	.95	NTU
CN (Total)	<.02	mg/l
Kjeldhal, Total, -N	.90	mg/l
NH_3-N. Sol.	<.02	mg/l
NO_3-NO_2-N	.01	mg/l
Phosphate Total	.015	mg/l
Chloride	7.0	mg/l
Sulphate	3.4	mg/l
Coliform Group	93	per 100 ml
Fecal Coliform	4	per 100 ml

WATER QUALITY ANALYSIS

LOCATION: Teulon
SAMPLE #: Dugout Two
DATE: September 16, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	328	umho/cm
Residue Total	190	mg/l
Residue Filterable	190	mg/l
Residue Non Filterable	<5.0	mg/l
pH	8.50	units
Alkalinity Total ($CaCO_3$)	176	mg/l
Alkalinity (HCO_3)	205	mg/l
Alkalinity (CO_3)	4.80	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	.001	mg/l
Cadmium (Ext)	<.001	mg/l
Copper (Ext)	.02	mg/l
Lead (Ext)	<.005	mg/l
Nickel (Ext)	<.005	mg/l
Zinc (Ext)	.02	mg/l
Chromium (Ext)	<.005	mg/l
Calcium (Ext)	23.7	mg/l
Magnesium (Ext)	25.9	mg/l
Hardness ($CaCO_3$)	166	mg/l
Manganese (Ext)	<.02	mg/l
Iron (Ext)	.07	mg/l
Potassium (Ext)	<5.00	mg/l
Sodium	1.7	mg/l
COD	43	mg/l
TOC	–	mg/l
Turbidity	1.0	NTU
CN (Total)	<.02	mg/l
Kjeldhal, Total, -N	1.0	mg/l
NH_3-N. Sol.	<.02	mg/l
NO_3-NO_2-N	<.01	mg/l
Phosphate Total	.20	mg/l
Chloride	3.0	mg/l
Sulphate	2.4	mg/l
Coliform Group	240	per 100 ml
Fecal Coliform	7	per 100 ml

WATER QUALITY ANALYSIS

LOCATION: Teulon

SAMPLE #: Dugout Three

DATE: September 16, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	581	umho/cm
Residue Total	350	mg/l
Residue Filterable	330	mg/l
Residue Non Filterable	20	mg/l
pH	7.90	units
Alkalinity Total ($CaCO_3$)	328	mg/l
Alkalinity (HCO_3)	400	mg/l
Alkalinity (CO_3)	0	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	<.001	mg/l
Cadmium (Ext)	<.001	mg/l
Copper (Ext)	.01	mg/l
Lead (Ext)	<.005	mg/l
Nickel (Ext)	<.005	mg/l
Zinc (Ext)	.17	mg/l
Chromium (Ext)	<.005	mg/l
Calcium (Ext)	53.9	mg/l
Magnesium (Ext)	43.4	mg/l
Hardness ($CaCO_3$)	313.	mg/l
Manganese (Ext)	<.02	mg/l
Iron (Ext)	.15	mg/l
Potassium (Ext)	<5.00	mg/l
Sodium	3.2	mg/l
COD	32	mg/l
TOC	-	mg/l
Turbidity	6.0	NTU
CN (Total)	<.02	mg/l
Kjeldhal, Total, -N	.65	mg/l
NH_3-N. Sol.	<.02	mg/l
NO_3-NO_2-N	<.01	mg/l
Phosphate Total	.015	mg/l
Chloride	4.0	mg/l
Sulphate	3.4	mg/l
Coliform Group	460	per 100 ml
Fecal Coliform	4	per 100 ml

APPENDIX C

GEOLOGIC LOG

LOCATION: Teulon Waste Disposal Site

TEST HOLE IDENTIFICATION: T.H. 1

DATE: July 13, 1985

TOTAL DEPTH: 3 Metres

WATER TABLE: N/A

TYPE OF CASING: N/A

TYPE OF SCREEN: N/A

DEPTH (METRES)	DESCRIPTION
0 - 1	silty clay
1 - 3	clay till, with some limestone gravel, dry.

CHAPTER - SEVENTEEN -

TREHERNE

R.M. OF SOUTH NORFOLK

SW 25-7-10W

17 TREHERNE WASTE DISPOSAL SITE

17.1 RECONNAISSANCE DATA

17.1.1 LOCATION

The Village of Treherne is located in the R.M. of South Norfolk and is located approximately 50 kilometres southwest of Portage la Prairie along P.T.H. 2. The waste disposal site is located 3.7 kilometres south of the Village on section SE 25-7-10W (see Figures 17.1 and 17.2 in Appendix A).

17.1.2 BACKGROUND

This waste disposal site has been operating on this location for over ten years. In 1977 the site was registered with the Province as an existing waste disposal grounds. Present records indicate that this site serves approximately 900 people. Primarily municipal waste from the Village of Treherne and household waste from the surrounding rural areas are deposited at this site. A trench system is used to dispose of common waste, while bulky metallic wastes are collected on the surface. Village water supply is derived from one well and distributed, rural residents derive their water from wells privately owned, set into the bedrock aquifer.

17.1.3 SITE CONDITIONS

During the site inspection on September 23, 1985, several observations were made. The site is located approximately 160 metres north of an east-west running section road, and is situated on the edge of a ravine running north.

The site covers an area of approximately 80 metres by 160 metres. The active area consists of a bulky waste piles and a trench, 70 metres long, 4 metres wide, and 3 metres deep.

The trench at this site is partially open on one end, the end facing the ravine. The site is situated on a sloping area with the bulky metallic waste pile situated on high ground, the tree waste pile in the middle of the site, followed by the trench at the low end of the site.

Waste is deposited in the trench, burned, and covered with fill when full. The site condition is good as the area is utilized and maintained efficiently. The site location is fair however, as a flowing well and a creek are situated in the ravine a few metres to the west.

17.1.4 PHYSIOGRAPHY

The site is located at the edge of the Manitoba western uplands, on the border of the lower Assiniboine Delta region, and the Pembina Mountains. The area consists of glacial end moraine flats with sharply rolling till ridges. Small drainage creeks and flowing wells form deep back cutting channels, such as seen at the waste disposal site.

The ravine adjacent to the site is approximately 15 metres deep, with a flowing well and creek draining towards the south to the Boyne River. Drainage on the site is into this ravine.

The area consists of a mixture of agricultural land and forested areas, trees line all back cutting channels in the area.

17.1.5 DRILLING AND SAMPLING

. A drilling program was not undertaken at this site, a sample of the creek was taken immediately below the site area. Analytical results of the water sample can be found in Appendix B.

17.2 GEOLOGIC DATA

17.2.1 GEOLOGIC SITTING

The study area is located on the ancient till ridges of the Darlingford Moraine which marks the edge of last glacial ice flow. The clay till overlying the shale bedrock in this area is very thin, thus regional topography strongly reflects underlying bedrock relief. (See Figure 17.3 in Appendix A).

17.2.2 BEDROCK

The bedrock underlying this area at approximately 3 metres below grade is Cretaceous, highly fractured shale.

17.2.3 OVERBURDEN

Approximately 3 metres of shaley clay overlie bedrock.

17.2.4 GEOHYDROLOGY

Only one type of aquifer exists in the area. The fractured shale bedrock, with a static water level of approximately 35-40 metres below grade at the site.

17.3 ENVIRONMENTAL INTERPRETATION ASSESSMENT

17.3.1 LEACHATE HYDROLOGY

Since the site is located in the fractured shale bedrock, with only a thin clay cover, snowmelt and precipitation is suspected to runoff into the nearby ravine, and to migrate into the bedrock aquifer, thus the bedrock shale aquifer is suspected to be affected by the site operation at its current location, to some extent.

17.3.2 METHANE

Based on the amount of waste deposited at this site an estimated 2.5 million cubic metres of methane gas may be produced per year. Since the waste is burned before burial, the actual suspected quantity of methane gas generated will only be a fraction of the estimate. Migration of methane gas generated should be limited to approximately 30 metres based on the soil conditions.

17.3.3 WATER QUALITY

Quality of the water sample taken from a pool, fed by runoff and ground water seepage, located in the ravine adjacent to the site can be considered fair to good. The analytical results show no apparent evidence of contamination from leachate or surface runoff from the site.

17.3.4 CONCLUSION

Based on the available data to date it appears that the site poses a low environmental impact to the area. Leachate migration into the fractured shale bedrock is suspected to be occurring to some extent. Since no wells or residences are located in the immediate vicinity, the extent of any leachate migration is of low concern. Overall the site is well kept and in good condition.

17.3.5 RECOMMENDATIONS

1. Future trenches should be located at least 10 metres from the edge of the embankment.

APPENDIX A

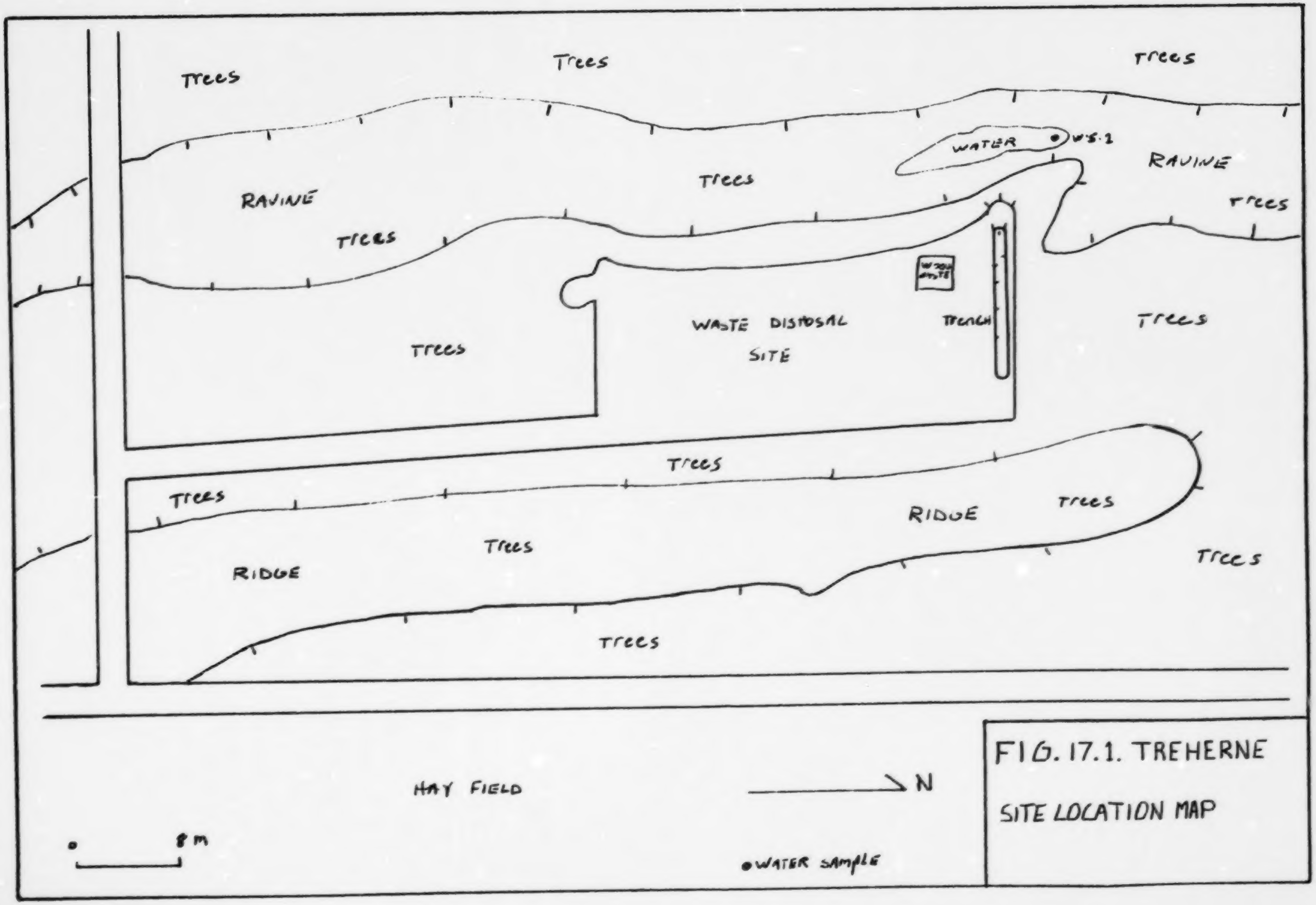

Trees
Trees
Trees
WATER
W.S.1
RAVINE
Trees
RAVINE
Trees
Trees
Trees
WASTE DISPOSAL SITE
TRENCH
Trees
Trees
Trees
RIDGE
Trees
Trees
RIDGE
Trees
Trees
HAY FIELD
N
0
8 m
● WATER SAMPLE

FIG. 17.1. TREHERNE SITE LOCATION MAP

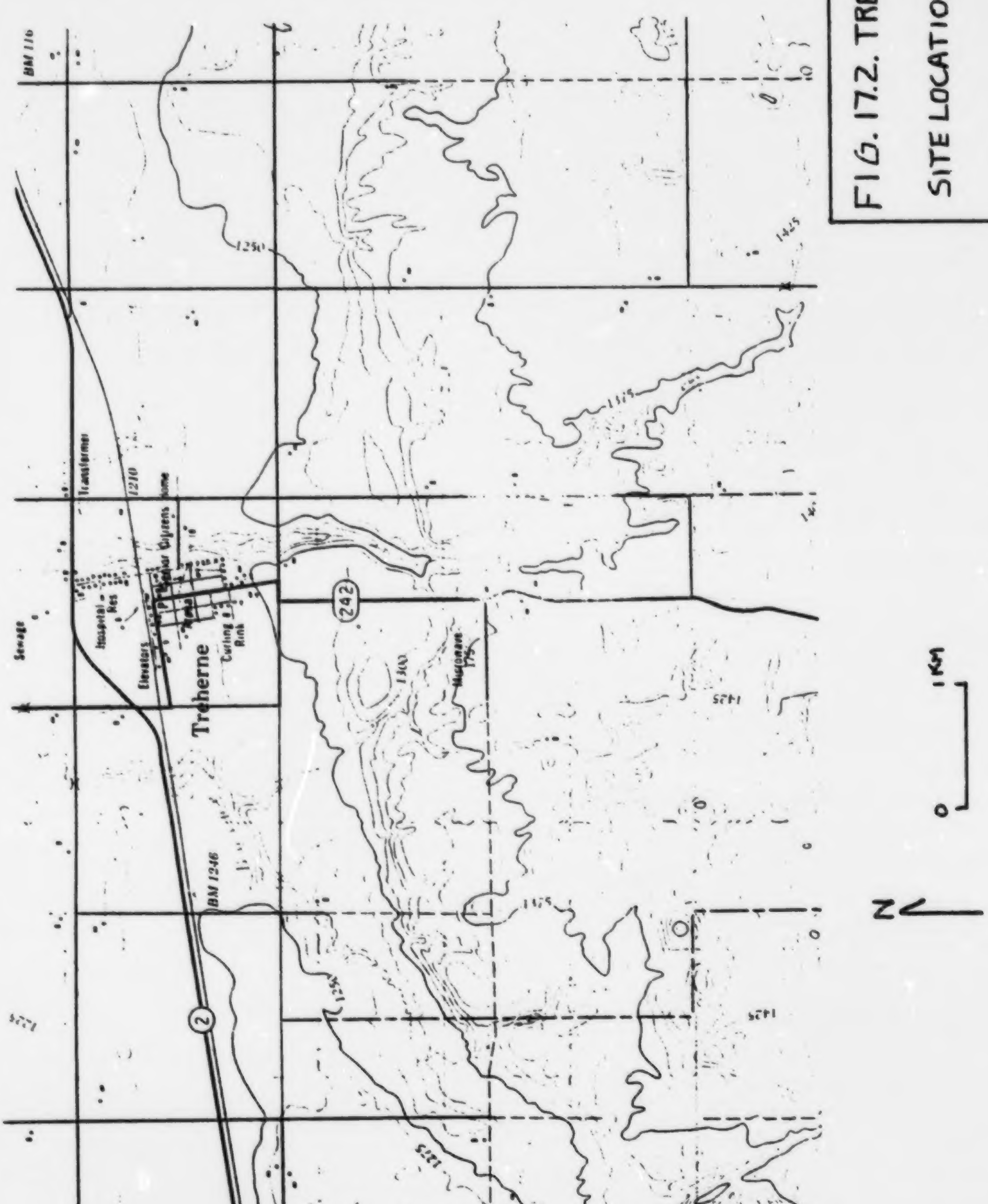

BM 116
Sewage
Transformer
Hospital Res
Elevators
Senior Citizens Home
Curling Rink
Treherne
1210
1250
1300
1375
1425
1225
BM 1246
2
242
0
1 KM
N

FIG. 17.2. TREHERNE SITE LOCATION MAP

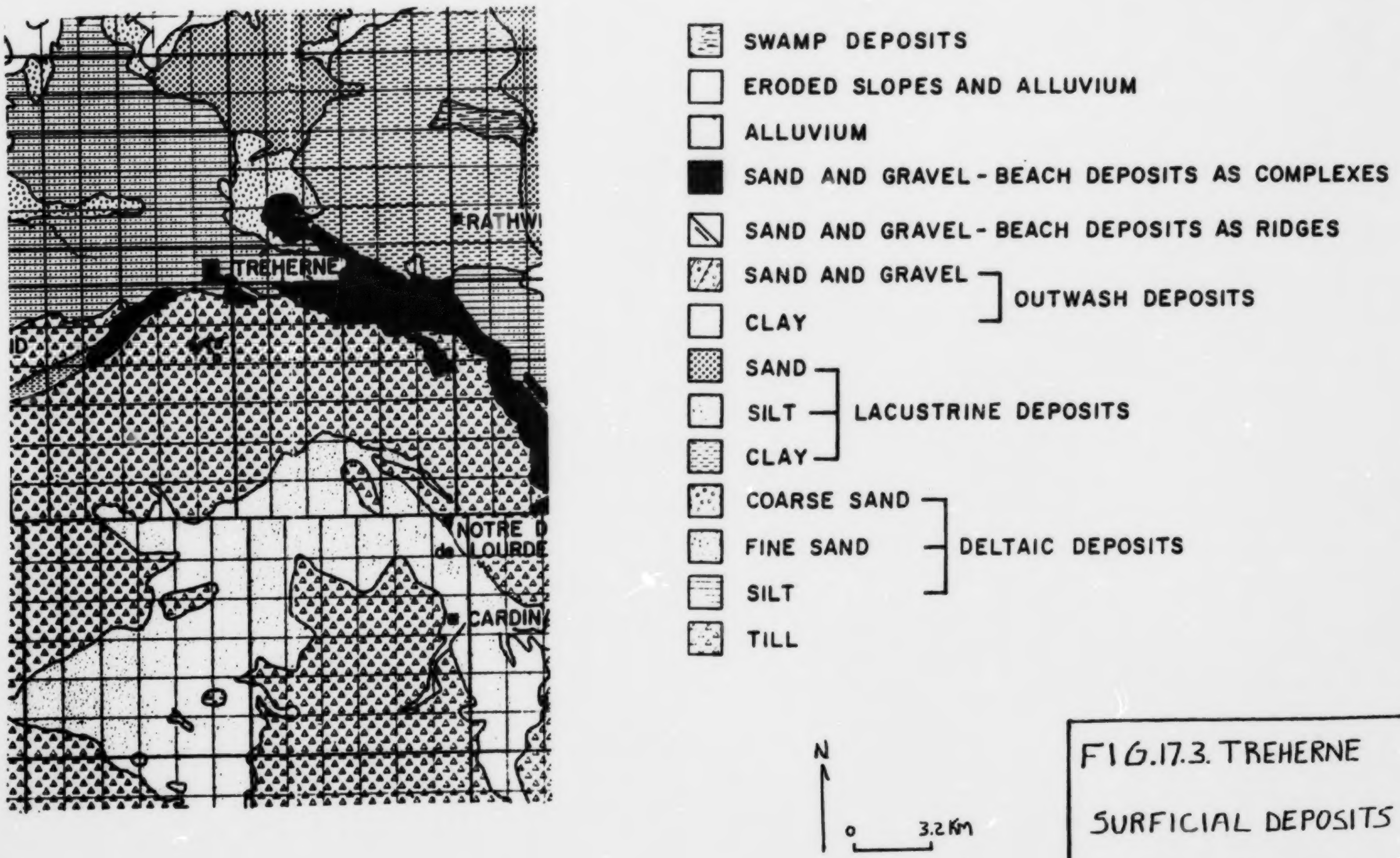

RATHW
TREHERNE
ID
NOTRE D
de LOURDE
CARDIN
SWAMP DEPOSITS
ERODED SLOPES AND ALLUVIUM
ALLUVIUM
SAND AND GRAVEL - BEACH DEPOSITS AS COMPLEXES
SAND AND GRAVEL - BEACH DEPOSITS AS RIDGES
SAND AND GRAVEL
CLAY
OUTWASH DEPOSITS
SAND
SILT
CLAY
LACUSTRINE DEPOSITS
COARSE SAND
FINE SAND
SILT
DELTAIC DEPOSITS
TILL
N
0
3.2 Km

FIG.17.3. TREHERNE SURFICIAL DEPOSITS MAP

APPENDIX B

WATER QUALITY ANALYSIS

LOCATION: Treherne
SAMPLE #: Sample One
DATE: September 23, 1985

PARAMETER	RESULT	MEASURED UNIT
Conductivity	1060	umho/cm
Residue Total	740	mg/l
Residue Filterable	740	mg/l
Residue Non Filterable	<5	mg/l
pH	7.65	units
Alkalinity Total ($CaCO_3$)	492	mg/l
Alkalinity (HCO_3)	600	mg/l
Alkalinity (CO_3)	0	mg/l
Alkalinity (OH)	0	mg/l
Arsenic Total	.001	mg/l
Cadmium (Ext)	<.001	mg/l
Copper (Ext)	<.01	mg/l
Lead (Ext)	<.005	mg/l
Nickel (Ext)	<.005	mg/l
Zinc (Ext)	<.01	mg/l
Chromium (Ext)	<.005	mg/l
Calcium (Ext)	125	mg/l
Magnesium (Ext)	56.6	mg/l
Hardness ($CaCO_3$)	545	mg/l
Manganese (Ext)	.62	mg/l
Iron (Ext)	.18	mg/l
Potassium (Ext)	6.50	mg/l
Sodium	40.0	mg/l
COD	47	mg/l
TOC	-	mg/l
Turbidity	1.0	NTU
CN (Total)	<.02	mg/l
Kjeldhal, Total, -N	.70	mg/l
NH_3-N. Sol.	<.02	mg/l
NO_3-NO_2-N	<.01	mg/l
Phosphate Total	.095	mg/l
Chloride	13	mg/l
Sulphate	118	mg/l
Coliform Group	93	per 100 ml
Fecal Coliform	4	per 100 ml

CHAPTER - EIGHTEEN -

WESTBOURNE

R.M. OF WESTBOURNE

LOT 30 PLAN 831

18 WESTBOURNE WASTE DISPOSAL SITE

18.1 RECONNAISSANCE DATA

18.1.1 LOCATION

The community of Westbourne is located in the R.M. of Westbourne, approximately 88 kilometres northwest of Winnipeg along P.T.H. 16. The waste disposal site is located approximately 600 metres north of the community on Lot 30 Plan 831 (see Figures 18.1 and 18.2 in Appendix A).

18.1.2 BACKGROUND

This waste disposal site has been operating in its present location for over ten years. In 1977, the site was registered with the province as an existing waste disposal grounds. Current records show that this site serves approximately 250 people. Primarily municipal waste from the community of Westbourne and household waste from surrounding rural residents is deposited at this site. An open surficial dumping method is used with no bulky metallic waste area. Because the bedrock aquifer in this area is unpotable, the rural and town water supply in the area is derived from the Whitemud River, upstream from the waste disposal ground.

18.1.3 SITE CONDITIONS

During the site inspection on September 4, 1985, several observations were made. The site is located off a gravel road which originates in the town and runs north, adjacent to the Canadian Pacific railway tracks, where it ends at the junction with P.T.H. 16. The site is located approximately 600 metres north of the town and 8 metres west of this gravel road.

The site is approximately 80 metres by 80 metres, with an active area consisting of a surficial dumping zone and a burning zone approximately 40 metres by 3 metres. The burned waste is pushed to the north and covered with fill, and is forming a dumping terrace. There is no separate area for bulky metallic waste. The site is fenced and is in good condition. The nearest residence is located 375 metres to the south.

18.1.4 PHYSIOGRAPHY

The area is located in the Lake Agassiz basin of the Manitoba Lowlands. The topography shows next to no relief other than drainage channels. The Whitemud River incised 2 to 3 metres into its alluvial channel bed meanders through the area towards Lake Manitoba. Small seasonal drainage streamlets form back cutting channels into the surrounding basin plain.

The terrain is mainly open prairie with trees supported only along channels and around farms. A shallow depression of a drainage streamlet passes immediately south of the site.

18.1.5 DRILLING AND SAMPLING

A drilling and sampling program was not undertaken at this site.

18.2 GEOLOGIC DATA

18.2.1 GEOLOGIC SETTING

The site area is located on Lake Agassiz basin clays. These clays overlie previously deposited glacial till which in turn overlies bedrock. The Whitemud River which is incised below the surrounding grade has reworked the sediments in its meander loops to form alluvium and expose the glacial till locally.

Sand and gravel lenses do not exist in the basin clays and only as small pockets in the clay till. As a result, the sediments are very low in overall permeability.

Rainfall is absorbed by the topsoil and transpires, with the excess running through streamlets into the Whitemud River.

18.2.2 BEDROCK

Fractured shale bedrock from the Jurassic Period underlies the site at a depth of approximately 45 metres below grade.

18.2.3 OVERBURDEN

Bedrock is overlain by approximately 40 metres of clay till with some layers of silt and small pockets of sand and gravel. Glacial basin clays form the upper 3 to 5 metres of overburden (Figure 18.3 in Appendix A).

18.2.4 GEOHYDROLOGY

The only major aquifer reported in the area consists of the saturated fractured bedrock. However, water quality is generally very poor and naturally high in salt content.

The overburden does not support any aquifers beneath the site area. Due to the impermeability of these sediments, the overburden forms a confining unit for the bedrock aquifer and no recharge occurs in this area.

18.3 ENVIRONMENTAL INTERPRETATION AND ASSESSMENT

18.3.1 LEACHATE HYDROLOGY

The quantity of leachate generated at this site is generally low based on the relatively small amount of waste deposited at this site yearly.

The majority of leachate generated is absorbed by the upper one metre of clay beneath the site. During periods of high snowmelt or rainfall, some leachate will be washed with the local runoff into the seasonal streamlet located adjacent to the site.

Overall leachate generation from normal site operation should not affect the surrounding environment beyond the site.

18.3.2 METHANE

Based on the amount of waste deposited at this site an estimated 0.5 million cubic metres of methane gas may be generated per year. Since the waste is burned before fill covering, the actual suspected quantity of methane gas generated will only be a fraction of the estimate. The migration distance of any methane gas generated should only be several metres.

18.3.3 WATER QUALITY

It appears that no aquifers in the area will be affected by this site. Water quality of the Whitemud River should not be affected. Also, cation contaminants will be absorbed by the soil in the site area.

18.3.4 CONCLUSION

The environmental impact of this site is low. Surface waters, groundwater and the Whitemud River should not be affected, due to the attenuation of contaminants in the clayey soil. Overall site operation and location are good.

18.3.5 RECOMMENDATIONS

1. A separate area for bulky metallic waste should be established.

APPENDIX A

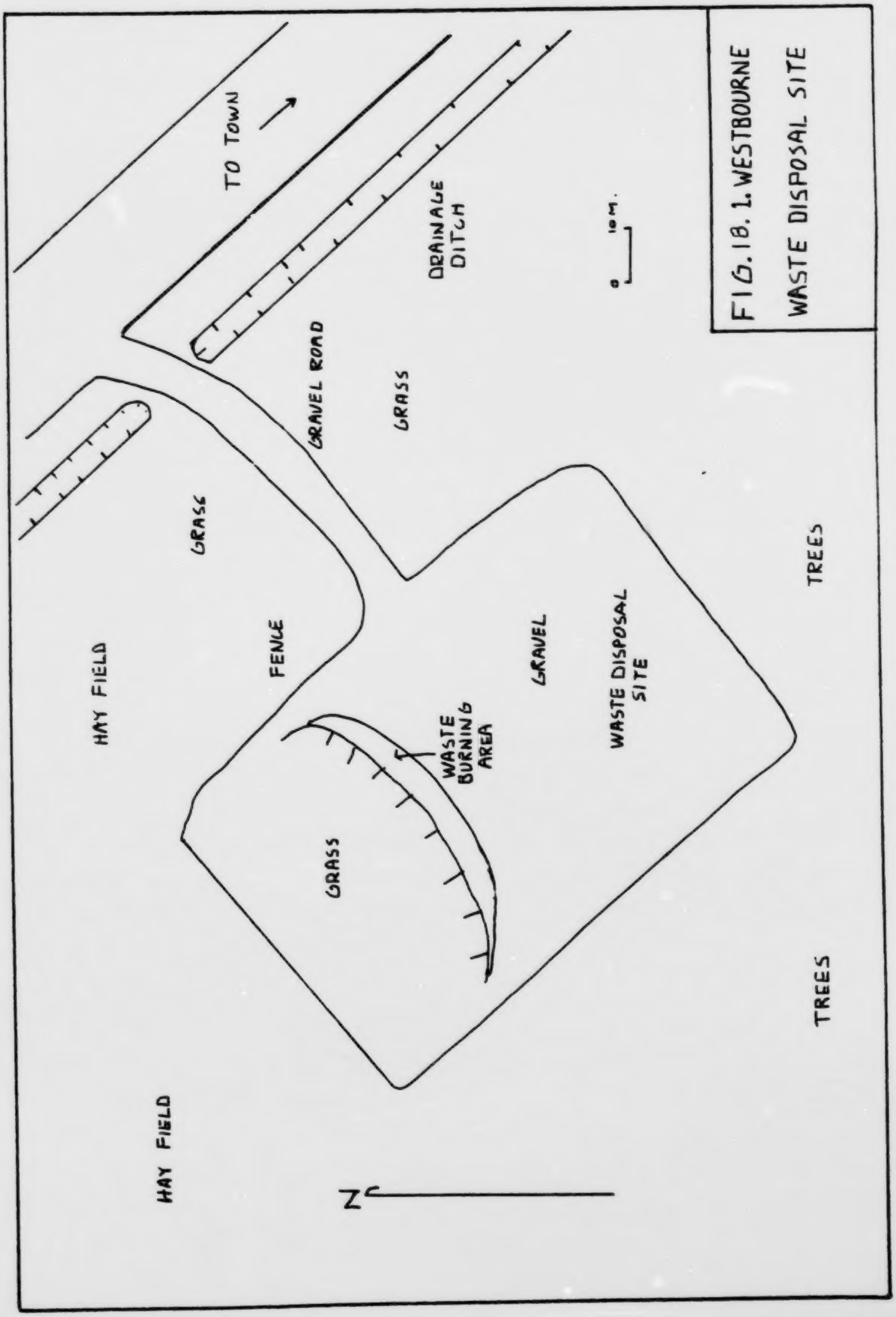

TO TOWN
DRAINAGE DITCH
0
10M.
GRAVEL ROAD
GRASS
GRASS
HAY FIELD
FENCE
GRAVEL
WASTE DISPOSAL SITE
WASTE BURNING AREA
GRASS
TREES
TREES
HAY FIELD
N

FIG. 1B. 1. WESTBOURNE WASTE DISPOSAL SITE

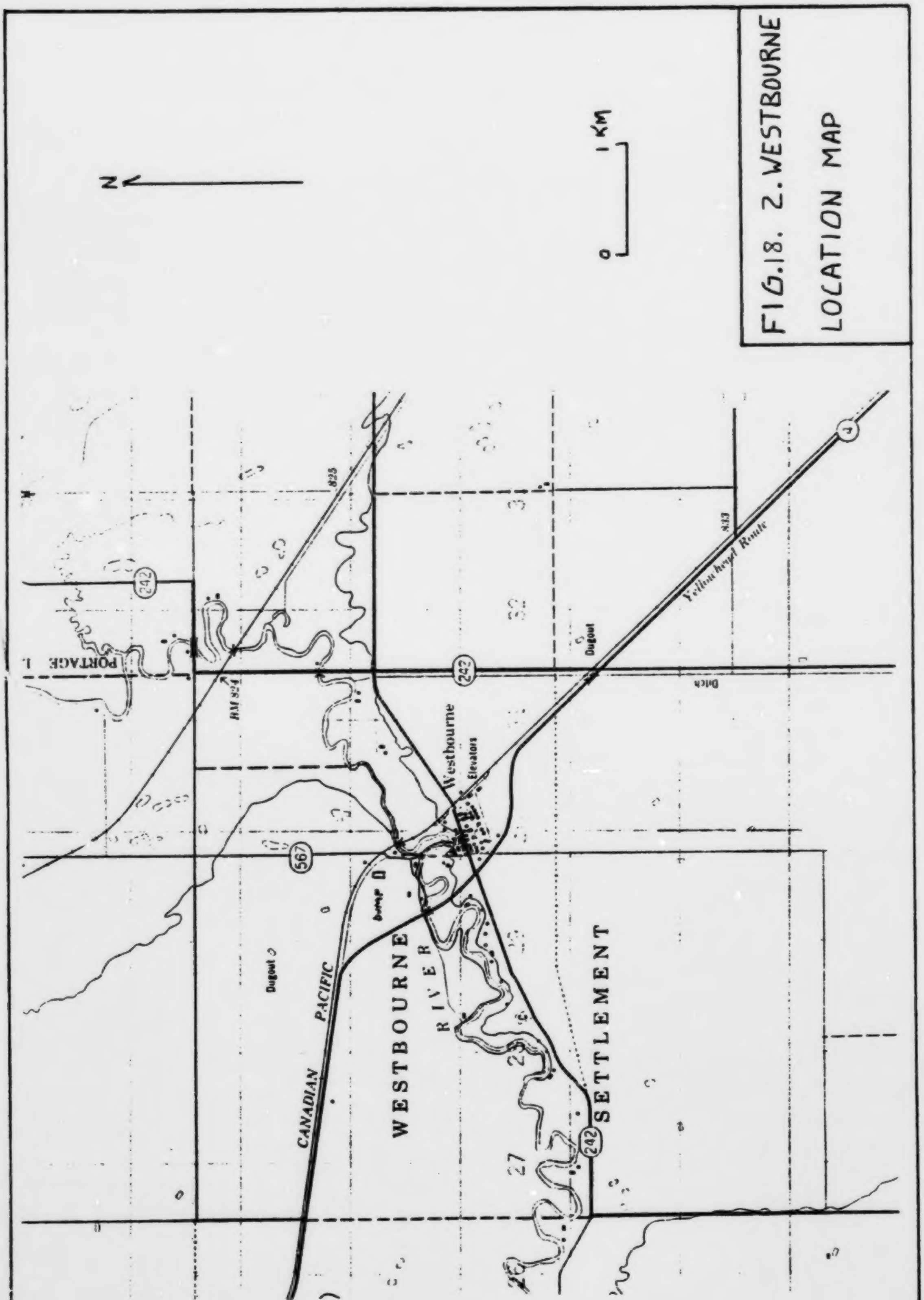

N
0
1 KM
PORTAGE L.
242
567
4
823
833
BM 924
Westbourne
Elevators
Dugout
Ditch
Yellowhead Route
Dump
CANADIAN PACIFIC
WESTBOURNE
RIVER
SETTLEMENT
27
28
32
33
35

FIG.18. 2.WESTBOURNE LOCATION MAP

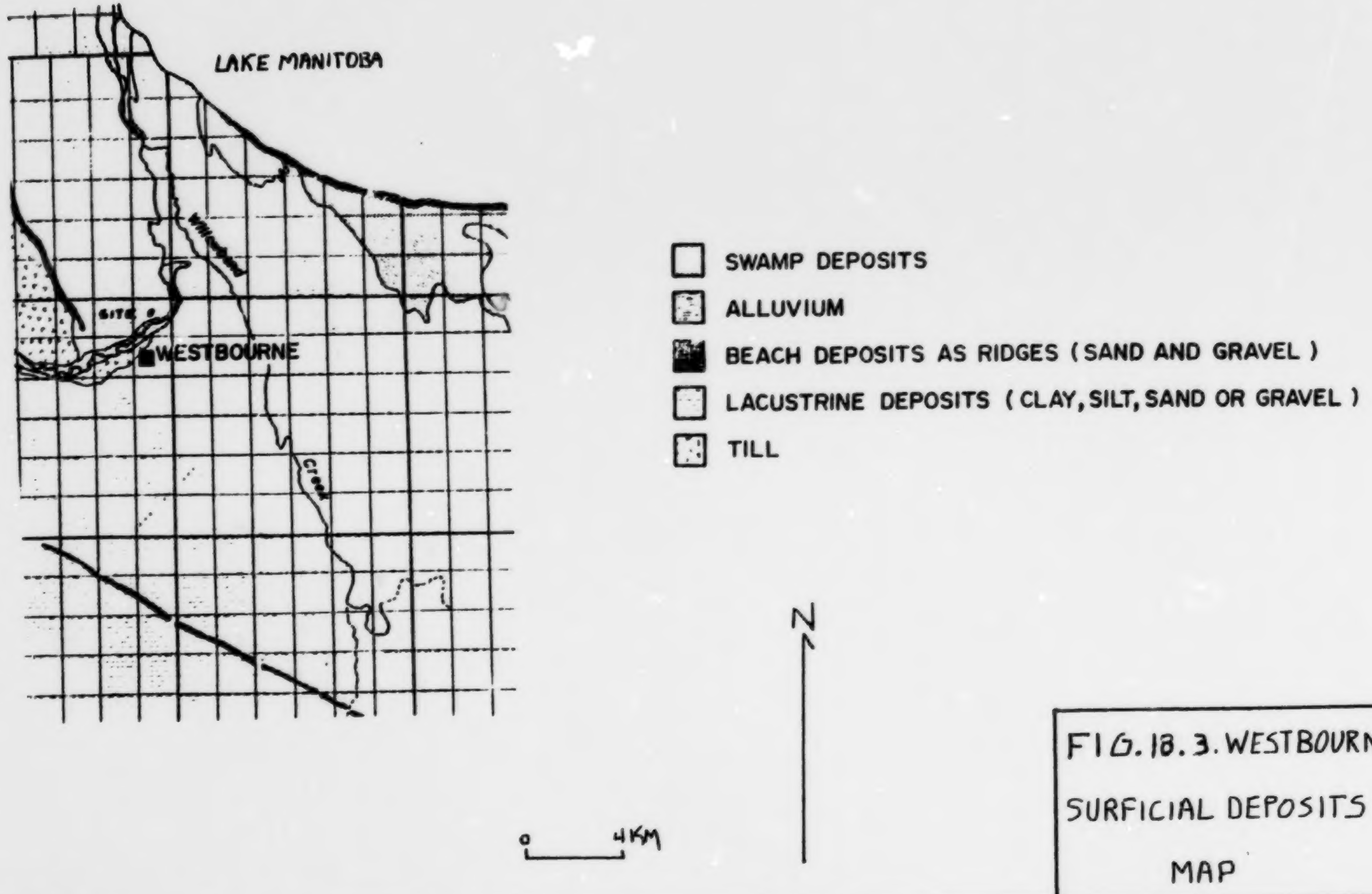

LAKE MANITOBA
SITE
WESTBOURNE
Creek
☐ SWAMP DEPOSITS
▨ ALLUVIUM
■ BEACH DEPOSITS AS RIDGES (SAND AND GRAVEL)
▨ LACUSTRINE DEPOSITS (CLAY, SILT, SAND OR GRAVEL)
▨ TILL
N
0
4KM

FIG. 18. 3. WESTBOURNE SURFICIAL DEPOSITS MAP